

September 9, 1963

Aviation Week & Space Technology

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Two-Seat Version**

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1E Longer-haul

1F High-density

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AEROSPACE CALENDAR

(Continued from page 5)

Conference: Super Flare, London, Eng-
land. Speeches: Institution of Electrical
Engineers (London), American Institute
of Aeronautics and Astronautics, Institute
of Electrical and Electronics Engineers,
International Society of Astronautics

Sept. 14-15-1963 Annual Convention and
Aircraft Show, National Aeronautics
Association, Minneapolis-Moline, Illinois

Sept. 20-21-Desired Annual Symposium on
the Physics of Vacuum in Electronics, Chi-
cago. (U) Sponsored: Royal Air Develop-
ment Command, American Research Founda-
tion

Sept. 22-24-Dynamics and Stability: Approaches
to Certification Control, Sheraton
Atlantic Hotel, New York, N. Y.

Sept. 23-Oct. 1-1963 Congress: Inter-
national Astronautical Federation, Paris

Sept. 27-28-Society of Experimental Test
Pilot's Seventh Annual Report to the
Aerospace Professions and Vendors Sum-
mit, Beverly Hills Hotel, Beverly Hills

Sept. 30-Oct. 3-Manned Interplanetary Ex-
ploration Meeting, American Institute of
Aeronautics and Astronautics, Office
Motor Hotel, Palo Alto, Calif.

Sept. 30-Oct. 3-Canadian Electronics Con-
ference: Institute of Electrical and Electron-
ics Engineers, Exhibition Place, Toronto

Oct. 1-2-Project Mercury Symposium: Civil
Frontier, NASA, National Aeronautics and
Space Administration, Houston, Tex. (By invitation)

Oct. 1-3-English National Symposium on
Space Electronics, Institute of Electrical
and Electronics Engineers, Farnborough
Hotel, Farnborough, W.

Oct. 15-National Aerospace Nuclear Safety
Topical Meeting, American Nuclear So-
ciety, Albuquerque, N. M. Co-sponsored:
Los Alamos Scientific Laboratory, AEC,
Mississippi Ordnance Laboratory, AF, Sp-
rit and Weapons Group, AF, Directorate of
Nuclear Safety, Sandia Corp., University
of New Mexico

Oct. 1-3-Engineering as Physics and Man-
agement: Training (unpublished), San
Antonio, Tex. Sponsored by Southwest
Research Institute

Oct. 1-4-First National Aerospace Nuclear
Safety Topical Meeting, American Nu-
clear Society, Albuquerque, N. M.

Oct. 2-4-National Air and Traffic Sys-
tems, Sheraton-Orlando Hotel, Or-
lando City, Fla.

Oct. 5-8-1963 International Aircraft
Display, Green International Park, Green-
field, Ind.

Oct. 7-Second Annual USAF Contract
Aerospace Systems Symposium, Detroit
Biltmore Hotel, Detroit, Ohio. Sponsored:
National Aerospace Services Ass.

Oct. 7-8-North Atlantic Communications
Symposium, Institute of Electrical and
Electronics Engineers, Hotel Ohio, Ohio

Oct. 7-8-International Air Transport Ass.
1963 Annual General Meeting, Rome,
Italy

Oct. 8-14-William Tell 1963, USAF In-
ceptor Wryposh Meet Tyndall AFB, Fla.
Host: Air Defense Command

Oct. 8-30-30th Annual Air Force Science
and Engineering Symposium, Air Force
Academy, Colorado Springs, Office of Air-
space Research, AFSC

(Continued on page 9)



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RCA also offers New Silicon NPN Transistor 2N2786 designed specifically for VHF Applications. The new RCA 2N2786 pinpoint oscillator transistor is specifically designed for VHF applications to 500 Mc. Here are some of the features of this new transistor:

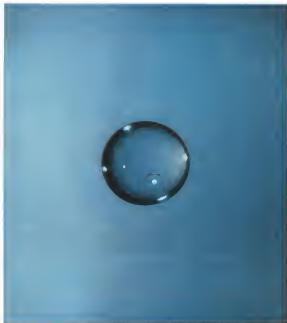
- 200 Mc wideband R.F. amplifier, 15 db max gain (unbalanced common-emitter)
- Maximum ratings: $V_{DS} = 35V$, $V_{GS} = 20V$, $V_{DS} = 3V$
- Gain-Bandwidth Product=700 Mc max
- NF=5.5 db max at 200 Mc, $I_C = 2$ ma

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Volume 39
Number 11

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Aviation Week & Space Technology

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EDITORIAL

Adm. Anderson's Departure 31

COVER: Republic Aviation Corp. F-105F two-seat version of the single-seat F-105D fighter-interceptor is shown in flight during Air Force evaluation tests currently under way at Tyne AB, Tex. The 1,490-mph jet is designed for the same missions as the F-105D and will be equipped with a radar-guided missile (see page 11). First test prototypes are being flown in the Spirit series with both engines operating.

NOTES

Great—Goodly: Republic Aviation Corp. F-105F two-seat version of the single-seat F-105D fighter-interceptor is shown in flight during Air Force evaluation tests currently under way at Tyne AB, Tex. The 1,490-mph jet is designed for the same missions as the F-105D and will be equipped with a radar-guided missile (see page 11). First test prototypes are being flown in the Spirit series with both engines operating.

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UH-5A

Access to machine matched to man
for inspection and maintenance from three levels:

- Access - access to engine compartment
- Intermediate - access to engine top, transmission, upper controls
- 3 Engine deck - access to rotor head



Access from front seats:
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system. Compartment doors are
maintenance platforms
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DESIGNER'S CHALLENGE: Give the Army's new LOH the maintenance simplicity and accessibility to live with the troops yet preserve the compact, continuously close machine needed for high speed missions. The UH-5A merges these apparent incompatibles — without compromise.

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DIVISION OF ELTRA CORPORATION

EDITORIAL

Adm. Anderson's Dissent

[Last week former Chief of Naval Operations Adm. George W. Anderson became the first high-level appointee of the Kennedy Administration to make a public attack on a number of controversial Defense Dept. policies (see p. 30). Because of the vital importance of those issues to the aerospace industry, *Aerospace Week & Space Technology* is presenting excerpts from Adm. Anderson's speech to the National Press Club.]

I am concerned regarding a trend in the senior procurement policies within the Dept. of Defense to the ultimate detriment of our military services. One proposal has been advanced which would in effect eliminate the requirement for specific recommendations by military personnel on matters such as design competition or source selection procedures. I view any demonstration of military recommendations on weapons procurement with great alarm. Certainly the abrupt reversal of military recommendations without serious consideration, as was the case in the JFEX and V-6STOL contracts, is a breach of a mission with implicit development, and potentially with grave danger. The civilian authorities exercising control, and the military, have two common objectives. First, to obtain the best weapons or systems system possible, second, to prevent the use of defense appropriations for anything except best performance for least cost.

I have spoken of the danger of making abrupt reversals in regard to procurement. The same reasoning applies to formulating defense policies with one ally. Specifically, a proposal made in the Weinberger affair appears from our encouraging our ally confidently to look forward to the timely availability of a response weapon when, apparently, we were not justified in giving them so much encouragement. This illustrates the need for continuous consultation between civilian and military experts and for avoiding abrupt actions forced to our own budget cycle.

At all important conferences involving our national security it would be of great benefit for our secretaries of defense to have with them a senior military representative from the Joint Chiefs of Staff.

I am concerned that, in the selection of weapons, or craft, or ships, there may not be a full appreciation of the desirability of a narrow edge in superior performance both to achieve maximum safety, and to succeed in combat. I am concerned that service experience tends to be subordinated to evaluation by operations analysis on the staff of the secretary of defense at involved in contract research activities.

Military experience holds an appreciation of the truth that slight weapons make big differences when the chips are down. Those who fought in the Pacific know that the narrow margin of operational superiority in the Japanese Zero fighter cost in American lives.

Creed of the military can be stifled. It is an error that those who criticize the military as being backward tend to be the very ones who are proponents of procedures and policies which would encourage a free

advice corps of military professionals. Today, by making too many detailed decisions at high level, we attempt to strip officers of all sources into a common mold we miss full initiative, imagination, and independent thought.

There is another alarming point to obscuring the role of the military, based in a modern fallacy that theories or computers or economics, or numbers of weapons was war. Alas, this do not. Good leadership, selflessly recognizes that man is the key to success or failure.

Military men have no crystal ball that can guarantee infallible decisions, but neither do scientists, available engineers, businessmen, lawyers, or for that matter computers—which must rely on human interpretation for inputs. All of us must learn reasoning based on success based assumptions that become self-deception.

I am concerned that the nature of checks and balances to which, provided for in our constitution and further translated into legislative code may increasingly be in process of growing unbalanced with respect to the Dept. of Defense. As members forget their partner in civilian control, the Congress, as a part of our checks and balances. On occasions, committees of Congress have been right; we in the executive departments wrong.

Overbalanced structures are evidence to the abuse of power and corresponding of mistakes. Meritocratic structured organizations can full imagination, selflessly assuming completely eliminate the effectiveness of those in the officer corps who have gained wisdom and experience.

Traditions, battle-tested checks and balances are provided in the National Security Act. One of them is the separate services, for they often take differing viewpoints and thus afford higher authority clear options and greater flexibility in decision-making.

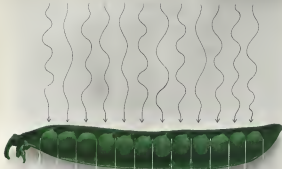
Within the department, another check is the Joint Chiefs of Staff. Never should this body become a political tool, or merely a rubber stamp to the secretary of defense in a policymaking decisions or carrying out orders. As a military body, the chiefs must represent military requirements from differing viewpoints, so that we do not ignore the value of speed, balanced, diversified forces. The joint chiefs should not be swayed with written that should be processed in service channels, and should their functions be taken over by segments of the office of the secretary.

Experience teaches that there are no infallible judgments with respect to national security in these times of the unknown, the changing and the unexpected. The best hope of surviving the pitfalls is found in a process which I commenced to those who lead the Dept. of Defense, now and in the future. It was stated by our President in his first State of the Union message, when he said:

"Let it be clear that this Administration recognizes the value of dissent and dissent, that we greet healthy controversy as the hallmark of healthy change."

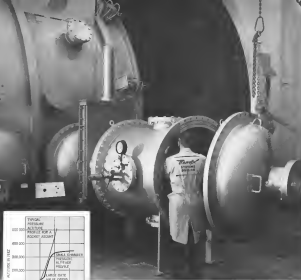
In the spirit of these wonderful words, I have given you the solicited by my military career.

► As Force is studying possible contributions that an advanced version of Gemini could make to its projected space missions, indications are that if the Titan 2 first stage motor was operated at about 45,000 lb thrust and its tanks increased, it could lift over a ton of additional payload.



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RISE-TO-ALTITUDE TEST FACILITY: The smooth 4-foot chamber attached to the large 30-ft test chamber has been designed and developed to duplicate the pressure history encountered by a rocket frame exposed to an altitude altitude. The large chamber retains vacuum environment. Isolated from the small chamber by airtight screened gate valve. The test sequence first evacuates the small chamber to a gas diffusion level. Then opens the valve to the large chamber which can be evacuated to a 1.0 Torr. The test chamber is the resulting approximation to the actual vehicle pressure history.

INSTANT SPACE SIMULATION (JUST ADD VACUUM). The rise-to-altitude chamber, to simulate pressure changes encountered by rocket-borne payloads, is a new addition to the Bendix environmental laboratories where engineers design, fabricate and test space vehicles. Engineers experienced in integration, assembly and test will find new careers at the Bendix Systems Division, Ann Arbor, Michigan. Write or call our Personnel Director.—An equal opportunity employer.

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**WHERE IDEAS
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THE FUTURE**

Washington Roundup

TFX Cost Confusion

Senate Permanent Investigating Subcommittee is still mulling that Defense Secretary Robert McNamara's reply to its cost-effectiveness studies showing the advantages of the TFX over existing Air Force and Navy aircraft (see p. 36).

The whole question of cost of the TFX is confusing to the committee and the totals are debatable even in the Pentagon. Estimates for the research and development program and production of 17,700 aircraft range from \$7 billion to 16 billion (AW Sept. 2, p. 17). The research program package also has to include operation and maintenance money. That could double the R&D plus production figure, as even if the \$7 billion is accurate, the package might total \$14 billion.

Air Force's longstanding plan to study the feasibility of a space station has finally received top-level approval after it was internally considered with the President's Scientific Advisory Committee, the National Aeronautics and Space Council, State Dept. and NASA (AW Sept. 2, p. 17). Proposal requests for the studies are expected to go to industry immediately.

Marshall Reorganization

Marshall Space Flight Center has further strengthened its ability to monitor contractors involved in building the Saturn launch complex for the Apollo program. Marshall's budget has grown to \$1.5 billion, and 90% of that now goes out to industry.

Part of a major reorganization aimed at coping with the overall growth and expanding contractors participation, the center recently hired Robert D. Young, former Airway-General vice president (AW Aug. 19, p. 25). Young's other new business Industrial Operations. Col. Lee B. James will head the Saturn 3 and 1B project office, Dr. Arthur Randolph will head the Saturn 5 office, and Edward Blevins III, engineer.

Nine technical divisions have been formed into a Research and Development Operations unit to be headed by Hermann K. Weidner. Dr. Donald H. Lange is moving from head of the old Saturn Systems Office to a new post as assistant director of the center for scientific and technical studies.

Joseph S. Isaac has resigned as assistant secretary of the Air Force for entitled to join Little Industries. His replacement is expected to come from outside the government.

Soviet Space Journal

USSR Academy of Sciences is publishing a new journal called Cosmic Research. Editor-in-chief Leonid I. Solov, who has headed the academy's space committee for years, and the biweekly paper it will be widely circulating all over the world. It will cover flight dynamics, celestial mechanics, cosmic phenomena, results of observations, instruments for cosmic research and design of cosmic apparatus, cosmic biology and cosmonautics. Solov said the journal will carry scientific papers by Soviet space workers and "we do not exclude the possibility" of printing papers "by foreign authors." The first issue was due to be published this month.

NASA will have a stronger voice in the standard space launch vehicle program as the result of an agreement with the Air Force concerning the use of the Lockheed Agusta ship. The two agencies have been operating only under a letter agreement since February, 1961. NASA now can go directly to the contractor for Agusta modifications instead of going through Air Force. NASA also will be represented on the USAF coordination committee headed by AF, then Agusta. Air Force also transferred complete responsibility to NASA for 31 Agusta B1 ships on order but not yet delivered.

Risks of Test Ban

A report highlighting the risks that would be involved in agreeing to a nuclear test ban is expected this week from the Senate Preparedness Investigating Subcommittee. It will blame the Senate Foreign Relations Committee report issued last week, which was strongly in favor of it.

The preparedness subcommittee is divided. Two members—Barry Goldwater and Strom Thurmond—are campaigning against Senate ratification of a treaty. Sen. Henry Jackson is skeptical about the treaty but not and is voting for it. Sen. Stuart Symington, a former Air Force senator, urged the favorable Foreign Relations report. Three other members—Levitt, Edmond and Margaret Chase Smith, and possibly Chairman John Stennis himself—are expected to vote in favor of ratification.

Poor Timing

Soviet Union, which claims to have invented almost everything, now claims that its Second Space Watch Plant has produced a watch for cosmonauts that uses a quartz crystal of an entirely new design. It turns out to be a timing ball vibrated at 300 cps. by an electromagnetic field created by magnets and a small battery. Solov reinforced a similar watch three years ago, based on the same principle. The watch is worn by U.S. astronauts and the basic Accutron timing device is used on the Explorer, Time, Telstar and Syncom satellites to select radio signals when desired.

—Washington Staff

Rift May Affect TFX Role, Configuration

F-111A low-level, conventional weapon delivery capability questioned; cost-effectiveness factor probed.

By Lynn Booda

Washington—Internal Defense Dept. controversy over the General Dynamics F-111A (TFX) Air Force version of the B-1 service tactical fighter could alter the aircraft's employment and configuration.

Against current plans, several F-111A mission profiles and its cost effectiveness have been used for the delivery of low nuclear weapons. Defense analysts have determined that as existing aircraft, the McDonnell F-4C can perform the mission as cheaply as the F-111A, although it lacks the 15 mm topersonic dash and long term range capabilities of the F-111A.

An Air Force Navy, director of defense research and engineering and the assistant secretary of defense/comptroller are engaged in the controversy.

At this point in the exchange of studies and reports, the office of the deputy DOD&E for technical warfare programs finds itself substantiating the primary deficiencies of two services, whose positions are prepared by experienced warfare analysis experts.

Comments by the cost-effectiveness analysis in the comptroller's office are continuing studies which began with Oklahoma Secretary Robert S. McInnis. McInnis alerted the Comptroller's Assistant Office, investigations that he did not only "rough judgment" in determining whether General Dynamics is fleeing but the more realistic cost of the F-111A (W 30 p. 24). These studies are going beyond the actual cost of the development and production program by examining the cost of delivering weapons on targets.

Air Force Requirement

Basically, what the Air Force wants in the F-111A configuration, and has wanted through the entire history of the TFX, was before McInnis made it a worldwide system, a variable mission wing aircraft which would carry a tactical nuclear weapon internally and be able to transport a target on the deck of Mach 1.2 for 15 min., at about 250 mi.

When the Air Force and Navy's requirements were combined, the capability for delivering conventional armaments was added as a requirement. This modification posed a problem, as the F-111 internal weapons bay could carry only a compact payload of limited weight. It would be too little for economical delivery of conventional armaments. To achieve this, armaments stores would have to be added to wing pylons, which in turn would make a topersonic low-altitude approach more costly in fuel and distance.

It is this point that the Navy has

been balancing in its studies. The Navy maintains that the F-111A is an expensive weapon for the low-altitude, low-altitude, low-altitude mission during conventional warfare. As a nuclear weapon delivery system, it is a much simpler strategic bomber with a subsonic speed capability.

According to the far air service officials and Navy studies dating as far back as two years showing that the F-4C as an attack configuration could deliver a larger payload of conventional weapons than the F-111, but without the tremendous range capability and low-altitude economic dash.

Navy's Position

The Navy has been questioning that a Mach 0.9 dash of low altitude is sufficient to accomplish the attack mission. The Air Force says that the speed advantage of Mach 1.2 could more than offset the difference between nuclear and tactical in area launch, defended by ground to air weapons and fighters.

Another point of contention has been whether cost-effective weapons such as tactical precision high explosive (HE) bombs could provide the expensive cost.

TSR-2 Production

London—British Aircraft Corp. has been given the go-ahead by the Ministry of Aviation to undertake production for TSR-2 (British style designation) bomber squadron production.

So far the order is for 20 airplanes to be used in both a development test program and Royal Air Force operations. The TSR-2, along with the Hawker P.1154 VTR, which will be built, will be the RAF's quick strike power when the V-bomber fleet is gradually phased out of service in the late 1970s.

The TSR-2 is scheduled to make its first flight in December or early January. It is due for shipment considerably later than a night bomber.

statement. The typical B1E explosive warhead begins to melt at about 2000 F. As a solid it is highly stable. Bombs can be dropped from light altitudes on our side without the bomb being armed and will not explode, although its fusing may occur.

A 15-mm topersonic dash, one source said, would heat the bomb bay to about 2000 F. The cockpit and engine compartment would be an environment, but not the bomb bay. A nuclear weapon could function at this temperature, but the B1E explosive would be more useful. When dropped, the bombs would explode on contact with the target. They would be triggered by the heat. Also, if one of the bombs hit earth or water, leaving the bomb bay, they would explode. Thus, hot constant low-altitude bombs would have to be developed, an added cost.

Coalpit Arrangement

The F-111A, which is now in full scale mockup form at the General Dynamics plant in Ft. Worth, has side-side cockpit seating. The aircraft has been designed to accommodate the General Dynamics A-10A tandem aircraft. The design engineers' suggestion of the mockup, conducted in the Air Force Aeronautical Systems Div. project office, began two weeks ago and is expected to be completed this week.

Even the side-by-side cockpit arrangement has been criticized by pilots. Since the pilot is seated on the left side, his view is hampered during light landings in approaching a target.

If the F-111A proves to be inadequate in the attack mission, an alternative is that it be used as an interceptor by the Air Defense Command. ADC has revised its requirement for a Mach 1.5 intercepter, but that little chance to have a new aircraft program approved. In performance, the F-111A is an intercepter as well as a Mach 2.5 plus aircraft. However, a completely different mission profile, for air to air, would require a completely redesigned layout of the ground guidance console designed for the attack mission.

As the backlog goes on, there is a growing sense of dissatisfaction among the senior key pilot officers of the Air Force and Navy regarding the entire program.

There is beginning to wonder whether the F-111 will ever become a production aircraft.

Senior officers have already become aware of the backlog and are working on internal reorganization programs to aid in the delivery of the aircraft's advantages and to emphasize the service's positive aspects.

Firms Picked for DH-125 U.S. Sales

De Harland DH-125 helicopter prototype aircraft, manufactured by Helicopter Technology, Ltd., in Great Britain, will be included in the U. S. for Marine Aircraft Corps and Air Force's Vietnam Service Corps, under terms of an agreement signed last week (W 30 p. 25).

Sales demonstration for the U. S. by a DH-125 is planned later this year. Federal Aviation Agency certification is expected by the end of 1968, and full delivery is scheduled for mid-1969.

Under terms of the agreement, Helicopter Technology, a division of the General Corp., would be DH-125 sales representative in state status of the Mississippi, plus state status of the Mississippi which border on the river.

Marine Aircraft Sales Corp., a subsidiary of Helicopter Technology Corp., of Wilmington, Del., would be sole representative in certain states.

Both companies would have the right to sell in the other country, with the condition to be decided on each sale. The company having production over the territory would then provide maintenance service.

Atlantic and Air Force will install interior and exterior equipment in customer specifications. Price will be \$750,000 without interior in interior gear. Fully equipped DH-125 is expected to sell for approximately \$750,000 to \$750,000 (W 30 p. 25).

Both companies will be licensed to provide software maintenance in states where the helicopter is not in service. Terms maintenance and control will be handled separately by General Corp., Memphis, and Helicopter Technology, Ltd., manufacturers of the aircraft's two Viper 20 engines.

TFX Probe to Focus on Possible Conflict in Galpatrice, Korth Roles

By George C. Wilson

Washington—Senate investigations of the F-111 (TFX) contract need not drag through years from technical considerations in its own phase and focus on a further probe. Defense Secretary Russell L. Galpatrice and Navy Secretary Fred Korth should have disqualified themselves from the selection process to avoid the type of conflict at the Supreme Court condensed in its Doves-Yates decision.

Although the senators began their have been investigations that previous associations with General Dynamics influenced their F-111 recommendations. But the outgoing Republicans of the Senate Permanent Investigations Sub-committee—with the backing of Chairman John E. McClellan (D-Ark.)—plan to go beyond this and examine the conflict-of-interest questions in detail where hearings resume, probably early next month.

There strategy is to emphasize that the Supreme Court has ruled public officials cannot contract with themselves, with their spouses, but must also avoid potential conflicts of interest when they are in the line of interest conflict. The court's Doves-Yates decision, which is complemented by the Kennedy Administration's own 1961 disclosure of conflict of interest, which declares, in part, that "even though a technical conflict of interest... is not in itself, it is desirable to avoid the appearance of such a conflict from a public confidence point of view."

Galpatrice had considerable legal work for General Dynamics before becoming deputy defense secretary, while Korth headed a Ft. Worth, Tex., bank which loaned money to the firm. Korth is from Ft. Worth, where General Dy-

namore will do its F-111 work. The program is expected to cost at least \$7 billion (W 30 p. 25). Both men have used their positions to avoid the conflict of interest.

However, Sen. McClellan himself feels there is enough pressure to initiate a defense investigation. Sen. McClellan will not attempt to make a legal case against the Defense officials, but he feels that Korth certainly should have exercised better judgment and disqualified himself from the F-111 competition just as he did in the X-22A aircraft vehicle selection process. Korth declared to participate in the X-22A competition because he formerly was a director of Bell Aerospace Corp., whose Aerospaces Division was Douglas Air-

craft (W 30 p. 25).
Navy had recommended that Douglas get the X-22A contract.

As for Galpatrice, his standing with Sen. McClellan is questionable when the deputy director, secretary under his of field and he did not know who gave the press a background briefing covering the recommendations F-111 investigation. A few days later Galpatrice admitted during a radio interview that he had given such a briefing. Sen. Galpatrice can expect little sympathy from Sen. McClellan when the Republicans on the investigations explore conflict of interest possibilities, even though it will be a Department-controlled administration challenging the ethics of a Democratic Administration.

Galpatrice came to his present Defense post from the Navy last year from Chief of Naval Operations. He has represented many defense contractors, including General Dynamics. Galpatrice told the Senate Armed Services Committee during his confirmation hearing Jan. 17, 1967, that since he was concerned "of all areas of society" from that firm, and I will have no financial or other interest in it, except that I will be paid some of money that will represent an interest in work that was done before I left the firm, but not long since, but some that represent the financial and uncollected work of the firm for past periods. But I repeat, I will have no interest whatever in the future business of the firm, and I will have no connection with it."

Although he said at the time he was prepared to step in the Defense Dept. "as long as I am asked to do so and feel I can be effective in doing so," Galpatrice announced plans not to depart the navy.

Galpatrice told the McClellan subcommittee last May 21 that after he left the post of assistant secretary of the Air Force in 1963, "I made it a matter of my personal policy never to represent any plant or any dealings with the Defense Dept.," adding that he would follow this more precisely if he returns to his again. "I did do certain work for Douglas and for General Dynamics," he said, "but I had no direct dealings with the Defense Dept."

Korth was president of the Continental National Bank in Ft. Worth when he was appointed as Navy secretary. He said the Senate Armed Services Committee at his confirmation hearing Jan. 18, 1962, that he had disposed of all stocks "which might have even a remote defense implication." He said at the time that when he left government, he was bound to return to the Continental National Bank. Korth and during the F-111 hearings that he had loaned General Dynamics less than \$600,000, citing its participation "in a small way" on a later that was

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Adm. Anderson Attacks Pentagon Policies

Washington—Former Chief of Naval Operations Adm. George W. Anderson last week accused on four Defense Dept. officials of "incompetent military, security, and intelligence policies, and even selection procedures involving low moral decisions at high levels and failing to stamp affairs with common sense."

Adm. Anderson, who was dropped as the Navy's chief after three years because of his opposition to Administration policies, including the TEX decision (see p. 20), is now serving as an advisor in Portugal.

In a speech made the day after his removal from duty, he said that Adm. Anderson said he is "gravely concerned that within the Defense Dept. there is not the degree of confidence and trust between the civilian and military, reflecting that the experience of a common language, common objectives, common responsibilities, requires a wider, respect and understanding from both sides."

Contrary Views

Expressing a military view in proper channels or making a direct negative to congressional inquiries does not mean a challenge, in civilian circles, he said. Military conduct is based on integrity, but the standard of integrity can be lowered greatly by negative actions or inappropriate judgments, Adm. Anderson said.

"I have no discussion of military

recommendations with grave alarm. Certainly the abrupt reversal of military recommendations without serious consideration, as was the case in the TEX and V-STIGL contracts, is fraught at a minimum with unpleasant developments, and potentially grave dangers."

Ground rules for competitive procurement must be clear, consistent and unswerving, Adm. Anderson said.

He applied the same reasoning to U.S. alliances with allies, specifically mentioning the cancellation of the Skybolt air-to-ground missile program after an ally had been encouraged to look forward to the availability of the weapon. Continuous consultation is necessary to avoid abrupt actions tied to the budget cycle, he added.

Adm. Anderson said a serious military perspective from the Joint Chiefs of Staff should participate in even internal decisions involving weapons programs along with the services of defense. This was an obvious allusion to the decision-making conference at which the Skybolt cancellation was announced to the British.

Adm. Anderson also defended the existence of separate services using Manofranchise structured organizations can kill weapons, which, however, completely eliminate the effectiveness of those in the affairs corps who have gained wisdom and experience. Over consultation at the top, and decision

agencies of initiative at lower relations can effectively measure reaction time in time."

Too many decisions are being made at higher levels than is necessary, and attempts are being made to stamp efforts into common molds, Adm. Anderson said. Different services take different positions on many matters, offering higher authority, clear opinions, and greater flexibility in making decisions, he said.

The desirability of having a common edge in the performance of a weapon is one to achieve greater unity and reaction in combat was stressed by Adm. Anderson.

"I am concerned that service experience tends to be subordinated to civilian opinion in operations, analysis on the staff, the services, of defense or involved in contract award activities," he said.

"I am distressed because, since the operations must properly concerned with 'not different'—seems to be working at the wrong end—along the service level rather than as an advisory capacity to the civilian, who should thoroughly appreciate his assistance."

Unhealthy Imbalance

Spent cannot without danger, anticipate their judgments are likely in which they do not have expert knowledge. Unfortunately, today in the Pentagon an unhealthy imbalance has resulted because as times specialists are used as experts in areas outside their fields. This has resulted in a tendency to shut conclusions before all the evidence has been considered," he said.

To guard this, he said, he said, senior staff officers are prepared to witness up against progress and new ideas, Adm. Anderson said.

Adm. Anderson made a plea that the Joint Chiefs of Staff's role should have their services be approached for four-year terms in order to achieve service stability. He pointed to the Marine Corps as an example.

The Joint Chiefs, he said, are part of the shield and balance of the U.S. government and should not become a rubber-stamp body. They "should not be swayed by matters that should be processed in service channels, nor should their functions be taken over by supporters of the office of the secretary," he said.

Adm. Anderson concluded by quoting from President Kennedy's first State of the Union address. "Let it be clear that this Administration recognizes the value of dissent and diversity, that we guard healthy controversy as the full mark of healthy change."

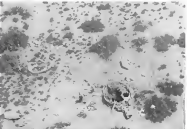
Little Joe 2 Shown With Dummy Module In First Flight Test



Fully proved Little Joe 2 in boost phase of SGM (above) is proved by an 18,000-lb thrust Aerojet-General Altair engine and an 84,000-lb thrust Thielert booster. The vehicle structure program used at about Mach 1.1 and a maximum altitude of about 34,000 ft.



Little Joe 2 is seen in firing position (above) for its successful first flight test at White Sands Range Aug. 12 (AW Sept. 3, p. 20). First standard Altair engine and dummy escape tower for the General Dynamics/Convair Little Joe 2 vehicle. Launch followed a 10-min countdown during which no health were as required. The vehicle's expected descent about 47,000 ft downrange after the approximately 15,000 ft, planned, as a result of a failure to ignite thrust when the Altair engine thrust engine did not work. About 300 sec. of telemetry was recorded during the flight of the Little Joe 2 vehicle.



High-Pressure Thrust Chambers Stifle-Fired

Port & Whitman, Texas, has successfully stabilized eight high-pressure metal thrust chambers, liquid fuel engines and liquid oxygen at the company's West Palm Beach, Fla., research and development center.

Most significant aspect of the firing, according to the company, was the successful demonstration of a rocket motor for the combustion chamber. Although Port & Whitman declined to reveal the exact technique used, it was believed that the method was transparent cooling in which a fluid flows through ports into the chamber to form a thin insulating film along the walls of the chamber.

Verne, at a high-pressure engine fire in the first test before permanent test to remove the specific aspects of the unit, by diverting combustion temperature and increasing exhaust gas density. Some cooling, however, is required for the thrust chamber, but the company found that the appropriate technique—a which the fuel is circulated in tubes along the outer wall of the escape port to circulation into the chamber—was inadequate. Addition and other techniques also were used. These chambers used in the case of four consisted of chamber, injector and nozzle and were intended to be about 10 in. long and 3.5 in. in diameter, with a throat exit of about 1.5 in. dia.

Thrust achieved was considerably about 11,000 lb. Chamber pressure was believed to be in order of magnitude greater than that of Port & Whitman's RL-16, which is about 300 psi. The USAF's Rocket Test Center, Edwards AFB, Calif., which operated part of the work related to engine test firing. Most of the work time, as the series was complete, finished.

The company said that the series, which was from the beginning of April through mid-July, 1964, indicates that successful development of the high-pressure concept—which many propulsion companies have been investigating—would lead the way to future engines with greatly increased thrust and improved fuel consumption, with little corresponding increase in physical size and weight.



FIRST EGYPTIAN-BUILT SUPERSONIC FIGHTER, based on the Spanish Hispano HA-300 designed by Willy Messerschmitt, is reported by Egyptian President Gamal Abdel Nasser (second from left). Original design relied on a laminated delta wing planform. One change evident is in the engine inlet, which has larger ducts and more complex geometry, and the wedge shape of the early concept. Dimensions of the original design were 41 ft. length and 22 ft. span.

Egypt Plans Satellite Launch Within Year

By Carl Bowles

Cairo—United Arab Republic, with a struggling aerospace industry that has largely sprung from the desert over the past three years, plans to launch a satellite into orbit within the next 12 months as a concrete example of the country's growing political/military strength in the areas of world affairs.

Designated "The Star" and developed primarily by a team of German technical experts working in Cairo, the satellite package has a primary mission of dramatically demonstrating Egypt's paramount role within the Middle East, its position of leadership within the "Arabia" bloc and its general technological edge under the aegis of President Gamal Abdel Nasser.

A cultural and military political capsule will be to represent the newly independent nations of Central Africa, a region in which Egypt and Israel already are engaging in a battle for supremacy of influence and prestige.

On the technical side, the satellite's payload will be mounted toward probing the earth's electromagnetic field. With the launch facilities currently available in Egypt, data received and tracking could pose serious problems, and some observers believe the launch may be delayed until adequate ground stations can be constructed.

Critics, however, believe the launch may be made as early as late November, and assert again that an attempt will be made to place the vehicle into a relatively low orbit of approximately 300 mi. India, next July 21, announced delay of the Egyptian revolution.

In a possible related move for follow-up launches of more sophisticated vehicles, Dr. Hassan Mansur, chairman of the country's Supreme Committee for Space Research, has recommended to

foreign launch-production agreement has been, as will be, signed with the Soviet Union.

Much of the know-how can be obtained through investigation of the SA-2 missile delivered directly to the UAR from Russia for the use of defense forces. Egypt's army and intelligence, particularly Cairo, Alexandria and the Sinai, Cairo. Over 100 SA-2s have arrived here thus far, and with the aid of Soviet technicians, construction of the concrete ground components is under way, with between 12 and 16 missiles scheduled for each individual site. Egyptians also reportedly are adapting the SA-2 for deployment.

While the SA-2 employs a solid propellant, Egypt's three tactical missile systems capable of use are liquid fuel, probably Luvovine and some and Al Kobra, which bears a family resemblance to the German V-2 of World War 2 vintage, has a reported range of 360 mi. Range of the smaller Al Zafu is quoted at 225 mi.

On the missile side, prototype of the UAR's Mach 2.2 light project, the HA-300, recently was rolled out from the new engine turbine manufacturing complex in use by Helwan Aircraft, based upon a design by Willy Messerschmitt (AW Apr. 22, 1957, p. 27), will be test flown in Egypt by an Indian pilot and an advanced engine design will be flight tested in India prior to serial production at Helwan.

The HA-300 bears a conceptual resemblance to India's HF-24 developed by Dr. Kesthik (AW Dec. 17, p. 68).

and to the Northrop T-38. The Egyptian fighter has a long nose cone, thin fuselage and thin wing section. Tank will and in the Indian tests of the aircraft's new engine developed at Helwan by Dr. Ferdinand Brander, noted American designer who helped develop the 12,000 cdy West K turbo-prop engine for the Russian Bom long range bomber while a Soviet prisoner after World War 2 (AW Apr. 3, 1957, p. 53).

Incorporating an advanced state-of-the-art design, including provision for use of a variable geometry inlet, the Brander engine began running on a Helwan test bench in mid-July and according to one observer, "not so far" "all expectations." Under present scheduling, serial production should begin within approximately one year's time.

Two of the engines, believed to have over 7,000 lb thrust each, will be used to power the HA-300.

To maintain the tempo of the air force test program for the HA-300 the prototype and possibly other initial aircraft of the line will be powered by two Bristol Siddeley Olympus 525 turbojets of 4,500 lb thrust each. In this configuration, the aircraft probably will be able to operate only in the lower supersonic stages. One spokesman says, however, that the aircraft can also be attributed to take the Brander powerplant once the test program has been completed.

HA-300 will be equipped with the Main-Mach 2.2 light project, the HA-300, recently was rolled out from the new engine turbine manufacturing complex in use by Helwan Aircraft, based upon a design by Willy Messerschmitt (AW Apr. 22, 1957, p. 27), will be test flown in Egypt by an Indian pilot and an advanced engine design will be flight tested in India prior to serial production at Helwan.

Winged tunnel tests on the HA-300 configuration in engine diffuser area location has been conducted in the United Kingdom, The Netherlands and

Switzerland. Majors of the aircraft components are being ordered directly from West European suppliers.

Aside from prestige, a primary reason behind Egypt's drive to establish an independent aerospace industry is its relevance to its dependent upon its outside power—East or West—for the equipment and support of its armed forces, a situation with which it is now faced to live.

The UAR, some observers say, has experienced difficulty in the past in obtaining sufficient spare parts from Russia for its series of Soviet MIG fighter aircraft. As a consequence, some components particularly for the MIG-21, have been fabricated on a local basis for the UAR aircraft at factories within West Asia.

In addition to the HA-300 and the HA-300 jet engine built under license from Spain's Hispano-Aviation, the Egyptian industry also is contemplating development and production of a short range transport, initially for use by United Arab Airlines on its internal route structure. Effort also probably would be made to export the aircraft to neighboring countries, particularly the newly independent African nations where in many instances there is a severe shortage of surface transport facilities.

The Helwan complex, officially inaugurated by President Nasser in July, 1962, is entering its pre-production work on the HA-300 rocket boosters, from which the first prototype appeared in Spain in 1955. Aircraft essentially as a Messerschmitt design.

A total of nine HA-300s, known as the Al Kobra in Egypt, are believed to have been built at Helwan, plus five of these expected in the July 21 SA-2s of Egyptian military aircraft.

A modified version of the HA-300's Turbofans Helwan 24, per engine also is now being produced at Helwan. First Egyptian model of the engine now placed on the test bench in April, 1962, and serial production got under way at June of this year. One of the Helwan, which have a static thrust of 580 lb each, are used to power the HA-300.

The Helwan complex, with approximately 17,000 sq ft. of floor space, was literally opened up since 1960 when Dr. Brander and other European experts began working for the UAR. En-gine facilities, listed as yet under way, is expected to be fed by operations by the end of the year. Training for both the airframe and engine lines has been placed almost entirely from Western Europe. A number of component parts also are still being produced in Europe and probably will be for some time to come, particularly in the case of accessories.

The Helopolis missile facility, on the other hand, is the outgrowth of an aircraft factory originally established there in 1958 for the licensed production of Walrus W-3 Becker BF 181 performance trainer.

With such a rapid buildup coupled with a thus background of experience, Egypt has laid its fate largely upon re-examination European engineers and technicians. Egyptian engineers, however, are being trained and schooled by the Europeans, both in the classroom and in the shop training procedures. Hundreds of large numbers of students also are being trained in mechanical engineering at schools here and abroad, and the Arab missile eventually plans to have the capability of supporting and expanding its aerospace industry with little or no assistance from outside technicians.



HOISTING OF A RUSSIAN-DESIGNED SA-2 anti-aircraft missile is shown being conducted in an Egyptian desert area.

M-2 Research Craft Landed Seven Times

Edwards AFB—Feasibility of landing a lightweight entry vehicle in the same manner as conventional aircraft is being investigated in the National Aeronautics and Space Administration's Flight Research Center with a low-cost, lightweight research craft designed for the M-2.

The M-2 has been successfully landed seven times following air drops from 12,000 to 15,000 ft in a flight test program which is to include another 15 to 18 flights over the next two months.

Other words of the flying body program which can be expected with the time M-2 vehicle include moving the cockpit forward for better visibility and streamlining the elevator. "One qualification to the basic M-2 powered craft would not require that a new vehicle be built. This air now being made to read tunnel results at Ames Research Center."

Combining the present test program with proposed modifications could turn M-2 recently through next spring. A potential follow-on to the present M-2 would be a full-weight vehicle of metal rather than plywood construction. It would be selected from various wind-tunnel model candidates and probably would be developed in the same manner as the X-15.

One objective of the follow-on research vehicle program would be to evaluate the lateral range capabilities of lifting-body re-entry vehicles at subsonic and transonic speeds. No follow-on program has been approved yet, however, NASA Test Pilot Milton Thompson, who flew from the M-2 on all flights, reported that handling characteristics of the M-2, with the exception of lateral control, are similar to winged aircraft.

The M-2, which has moderate and positive response, showed all areas, is susceptible to turbulence, and entry wind conditions because of its limited lateral stability. Stability augmentation is not incorporated in the vehicle but is considered a necessary feature for advanced models.

The full-scale design, wingless vehicle was based on an original design and used tunnel work at Ames Research Center (AFCM 18, p. 52). The M-2 is fabricated of 4-in. radioglypt plywood and balsa wood. Its nose is three glass on the upper portion and plywood on the lower sections for better visibility at high angles of attack.

The M-2 is 20 ft long, 30 ft high and 15 ft wide. Its weight with pilot is 1,150 lb. Control surfaces are steel cables in wire, elevator on each side of the vertical fin for roll and pitch augmentation, and trailing edge flaps for pitch.



M-2 RESEARCH VEHICLE, piloted by NASA's Milton G. Thompson, began a third air drop at Rogers Dry Lake bed today for a C-47. M-2 then is hoisted (below) to 15,000 ft. M-2 has been successfully landed seven times after air drops.



Cost of the M-2 up to the first flight was estimated at \$60,000. That included \$35,000 for the vehicle and \$42,000 in related costs such as engineering. The relatively low cost of the vehicle has been achieved primarily through lightweight construction and maintaining simplicity in design.

The on-line program, following investigation of stability during ground tests, used a C-47 with a 1,000 ft rope rope. Flights were made only in the due to wind, smooth and turbulent conditions. During the two flights to altitudes of 12,000 and 15,000 ft (MSL) the M-2 was flown higher than the C-47 to stay out of the aircraft's wake. Tow speed was 130-145 kt. Following release, about over the point of intended landing, full left rudder and left stick were applied to guide the M-2 to the left of the aircraft's wake. A standard technique of balancing out attitude and position from the point of touchdown, just as used in filament approach maneuver, was adapted to reach the point of intended landing.

The M-2 was glided between 115 and 130 kt with a rate of descent of about 4,000 fpm up to the final portion of

the approach. During that time it was doing less efficiently than its optimum maximum stage speed of 75 kt which would give it a glide ratio of approximately 1:2 at an angle of attack of 12 deg. Therefore, altitude is most efficiently lost by increasing speed during the 360-deg descent to keep from losing height. Landings between 75-80 ft were made on the dry lake bed. Other features of the M-2 include:

- Nose wheel steering.
- A 240-lb solid-propellant rocket for emergency propulsion during landing or takeoff. The rocket, called "Instant V-4" (left over drag) would be used to decrease rate of deceleration and would provide extra thrust to maintain.
- Two tail skids preventing over-rotation and damage to the aft portion of the vehicle. When the aircraft is rotated to the tail skids, such as an elevator, the vehicle is at an angle of attack of 13 deg.
- Lightweight, rubber socket-mounted precision steel joints into which have capabilities. Addition of the specimen seat and other modifications forced the original weight might up from a planned 800 lb to 1,150 lb.

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BTR-IV

ELASTOMER



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This new material from Lord research offers elastomeric resiliency that combine superior broad temperature characteristics with important price advantages. ■ BTR-IV, already being designed into shock and vibration mountings of many types, joins the family of BTR® (broad temperature range) elastomers introduced by Lord in 1957. ■ Performance: excellent shock attenuation from -65° to +160 F. Lesser load-deflection characteristics under high shock. Good damping, load strength and impact fatigue resistance. No detrimental stiffening at -65 F. Meets MIL specs. ■ Lord is ready to put BTR-IV to work for you now. For an Engineering Report on its performance, contact: Lord Manufacturing Company, Inc. Field Engineering Offices in principal cities. In Canada: Railway & Power Engineering Corp., Ltd.



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Model 6104 Up to 4 serial time-of-day codes simultaneously—standard pulse rates—decimal display—stability to 1 part in 10⁶

Model 6108 Up to 4 serial time-of-day codes... standard pulse rates—binary display—stability to 1 part in 10⁶

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Model 6200 UNIVERSAL... translates all serial time codes to decimal display—parallel BCD output—Tape Search and Control Units, Models 6204, 6205, 6220 available for universal automatic tape search

Model 6204 translates serial time codes—provides parallel output and display correlated with serial code format

Model 6205 translates time-of-day serial code to parallel output and binary display

Model 6206 converts input serial time code to time-of-day display

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For consultation assistance when considering your timing system, contact your nearest Astrodata representative or write: The Astrodata Division, Boeing Street



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Six Fastener Companies Indicted In Federal Price-Fixing Charges

Los Angeles—Two-pronged suit filed action has been filed here by the federal government against manufacturers and distributors of most of the self-locking nuts sold in this country.

Six firms and three individuals have been charged with violation of the Sherman Anti-Trust Act in a federal grand jury indictment returned to the U.S. District Court here. The indictment charges the defendants of conspiring in a "continuing agreement and concert of action to raise, fix, maintain and stabilize prices for the sale of self-locking nuts."

An accompanying civil complaint or demand by Attorney General Robert F. Kennedy was filed in the same court against four firms, including those named in the criminal action. The civil complaint asked the court to halt the alleged price-fixing and to order the companies to raise new price lists and discontinue claims based upon "individual merit figures and individual judgments as to prices."

List of Defendants

Firms named in the criminal indictment were:

- Elastic Stop Nut Corp. of America, Union, N. J., and the Collins Power Co. of Newark, N.J., accused by Kennedy in August, 1969, and operated as a subsidiary.
- Kayser Mfg. Co., Inc., Richfield, Calif.
- Standard Pressed Steel Co., Jenkintown, Pa.
- Townsend Co., Norwalk, Conn., which last November was merged into Tuxton Industries, Inc., Providence, R. I., and Boon Enterprises, Norwalk, which was acquired by Townsend in November, 1969.

Individuals named in the criminal indictment were: W. F. McGowan, president of Elastic Stop Nut, Frank S. Kline, president of Kennametal, and H. Thomas "Hal" Howell, Jr., president of Standard Pressed Steel.

The civil complaint was filed against Elastic Stop Nut, Kennametal, Standard Pressed Steel and Tuxton.

The criminal indictment charged the price-fixing began prior to January, 1956, and continued until at least October, 1962. As a result of the price fixing, the indictment said, price increases among the corporate defendants was "exaggerated," and purchasers were "deprived of the opportunity to purchase self-locking nuts at competitive prices."

The civil complaint repeated the same allegations, with the added charge

that "defendants will continue and use their continuing and concerted action to keep prices of self-locking nuts artificially inflated." The charge in some corporate defendants from the criminal indictment is due to changes in corporate status and activities of those individuals named in the civil action is based on alleged current activities.

According to the indictment, 1962 sales in the several companies of pertinent self-locking nuts were: Kennametal, \$5,000,000; Elastic Stop Nut, \$4,400,000; Standard Pressed Steel, \$1,015,000; and Collins Power Co. (a distributor only), \$1,150,000.

Total sales were said to amount to 97% of the \$10.6-billion of the pertinent type of self-locking nuts sold in this country last year.

Limited Reaction

Reaction of the companies involved in the criminal indictment was limited. A spokesman for Kayser said that company's president, Kline, said it is a company policy not to comment upon pending litigation. He added, however, that it is "our policy to show all federal and state officials."

A legal spokesman for Standard and its president, Howell, said he shows has been opposing policy to reduce the price level and the spread of the law. An officer of Elastic and as a result of it and McGowan. "The indictment came as a great surprise to us. There is no basis for the charges."

Testimony Statement

In Providence, a Tuxton spokesman said Tuxton's price sheet has been to acquire strict compliance with the antitrust law is, all of its companies. Boon Arrant Nut was acquired by Townsend in 1960. "We are not aware of any such indicating violation by officials of Boon."

Self-locking nuts involved in the action appear to cover practically all of that type of fastener used in the aerospace industry. An anti-trust attorney said the term is used in the indictment means those special type of nut varieties on qualified under National Air Standards and military standards.

One company spokesman said his firm made 6,000 fastener-type items, and the self-locking nuts involved accounted less than 15% of production.

News Digest

Boeing Co. has won a \$6-million Advanced Research Projects Agency contract for the High-C Boost (HCB) rocket. The contract is a part of the Hardpoint and Submarine missile program. Boeing will do research and development and produce 12 to 16 vehicles at Seattle, Wash. Testing will be done either at White Sands, N. M., Vandenberg AFB, Calif., or Cape Canaveral, Fla.

First of an USAF/McDonnell Aircraft Corp. ASSET-7 plane scheduled to be flown about 500 mi. down the Atlantic Missile Range next week aboard a specially modified Thor 10851. The plane will be a 1,100-lb. three-engine aircraft (AW 800, 10, 30) and will gather data on temperature, heat flux and pressure distributions on a lift-in, lock-down mission.

Spilloe space satellite engine was started and stopped 11 times in a test run during a recent 900-sec test of the engine's multipoint capability at Arnold Engineering, Sacramento, Calif. Throat degradation was within specified tolerances.

Phoenix Corp. last week received a program definition phase contract for the aerial vehicle communications control system (ASAC) which will be the principal terminal for Defense Dept.'s medium-altitude communications in the Midland, Md., Systems Development, Inc., will be a major subcontractor in Phoenix.

Vice Adm. Wilbur F. Rabson, who recently assumed a director of Naval Special Projects Office, has joined Armstrong-Goddard Corp. as vice president for program management at El Monte, Calif.

Polio Corp. is developing manufacturing of transistors and its Lavalin's semiconductor operations. Lavalin will continue work to microcircuits and special semiconductor products. The company is the second organization within one month to close transistor production. Timp Bell designed its transistor lines only last month.

Two jet-powered assembly plants, under a single contract, a single Lockheed Agusta vehicle, were launched recently by Air Force. The two aircraft facilities, TR-3 and 3, were built in Space Technology Laboratories, Inc.

Army Nike Zeus missile has made two missile successful intercepts of ICBM targets launched by USAF from Van Douglas AFB. Latest targets were Titan I and Atlas ICBM boosters.

FAA, Eastern Test 'Silent Clearance' Plan

Procedure to reduce ATC communications volume is being evaluated on New York-Washington shuttle.

By James R. Ashlock

New York-New procedure called the "silent clearance" is being evaluated on Eastern Air Lines shuttle flights in the Federal Aviation Agency's quest of a means to reduce the growing volume of air traffic control radio conversations on high density routes.

Speakers for the FAA explained that the proposed procedure involves a compilation of all the factors involved in an instrument flight rule (IFR) clearance, such as turn instructions, route, altitude assignments, radio frequencies and radar transponder assignments.

These factors are then applied to specific routes, those from New York-LaGuardia to Washington National, for example. Consequently, a pilot proceeding to fly from New York to Washington on an auto-rotary flight according to the pre-determined route and file it with the air route traffic control center, needs 10 minutes before he anticipated departure time.

When he is ready to take off, the

the route, the pilot calls the airport tower, gives his aircraft identification number, and says "silent clearance, at this Washington."

These are actually a code, referring tower personnel that the pilot has acquired himself with the required procedures, including the two minutes to the active runway and the flight pattern to the point where he is headed off to en-

tail of the air route traffic control center. Then, if he is cleared to taxi, the tower has only to acknowledge receipt of the pilot's call.

Under present procedures, tower personnel give out a stream of instructions on frequency and runway. Subsequently, the pilot issues a further list of clearances and departure routing data on the ground control frequency. All of this, the FAA hopes, can be eliminated or substantially reduced by the silent clearance arrangement. The airlines hope to simplify the paperwork involved in an IFR clearance.

Reduced Communications

"Elimination of a need to use oral two-way communications will substantially reduce the amount of communications actually required," said Oswald S. Collins, director of operations for the FAA's New York Eastern.

Collins explained that "silent clearances" would be issued by a ground-based IFR clearance controller on an approval of the air route traffic control center. In effect, the controller is not directly approved until orally confirmed by the center once the flight is under way.

"It is extremely important that pilots recognize the necessity of this clear clearance," Collins said. "This is the point on which we expected the most problems during the evaluation, but actually it has proved to be difficult."

Upon calling the air route traffic control center, the pilot has only to call to it that he is in its frequency. But until the oral clearance is given, he must maintain the altitude assigned on his flight. In this particular respect of his flight, IFR through but "silent clearance" can call for a higher cruising altitude, he cannot proceed toward it until receiving the center clearance.

Altitudes Aligned

Collins explained that although the "silent clearance" package contains a standard preferred cruising altitude for the specified route, some is left for alternate altitudes that may be better due to weather conditions.

"What we tried to do is drawing them up to be able to make two or three what happens 90% of the time," he said. "But we also had to consider the varying factors."

Pilots can therefore request alternate altitudes, with all other clearances in the "silent clearance" package remaining the same, thereby leaving radio talk to merely obtaining the altitude change.



VICKERS VISCOUNT GLASS, shown parked on the line at Heath, England, site of British Airways Corp's main assembly plant, is fourth aircraft in a series of five to be ordered by Red China. Three more B747 Viscounts G-ASBP, G-ASBP and G-ASBP have already been ordered by Peking by BAC crews. A sixth Viscount is presently being built for delivery to China. Aircraft shown here has been painted with top upper hull, while bottom is unpainted aluminum. Note temporary registration markings on lower fuselage: all of landing, flight and ground markings are in English and are changed after delivery to China. Aircraft for China are painted by Red-Rose Ltd. KDC 747 (Mark 520) copies of 1990 day at today.

Red China Air Expansion Seen

Washington—U.S. is now attempting the new Pakistan believed an important agreement (AW Sept. 3, p. 31) as a first step in a Red China drive to open international routes that will lead it with its European ally, Algeria, and pursue further expansion into Africa and beyond to Cuba and Latin America.

The growing contention over the agreement has drawn threats from India to abrogate its air pact with Pakistan and cancel a "postponement" of a \$4.4 billion U.S. loan to Pakistan. The dispute has again focused attention on the close consultation between air transport and international politics (AW Sept. 3, p. 31).

Although no specific work is being scheduled, flight frequencies had been worked out between Pakistan and China as of late last week, it was clear that negotiations were conducted in a harmonious atmosphere. The bilateral pact for reciprocal traffic rights between Dacca, Karachi and Lahore in Pakistan and Shanghai and Canton in Red China was signed last week by Pakistan International Airlines in Tokyo.

The Chinese will permit American and other international passengers aboard Pakistan flights to enter Red China as well as Tokyo without a Chinese transit visa and to disembark at the Chinese terminal during stopovers. Service is expected to begin early next year.

Chief problem facing the Chinese air expansion program will be in obtaining transit rights over numerous airways to permit, in which it obtains landing rights. Fights of the Soviet aircraft, Aeroflot, to win such rights from

Western European nations forced the center to negotiate its ties to Cuba from Moscow, across the Bering Sea north of the Bering Sea peninsula.

However, the Red Chinese government has said information into African parts of Africa and into Cuba and wants to establish aerial connections with these areas.

Under the agreement, China will expand routes at both the Canton and Shanghai airports to accommodate Pakistan Boeing 747s transports. The Communist Chinese airline, operated by the Civil Aviation Administration of China will fly Vickers Viscount turboprop transports on the route. In Viscount, have been purchased from the British (see photo above).

Meanwhile, Prime Minister Jawaharlal Nehru of India last week and India would refuse Red China first and second independent rights to fly over India or land for emergency reasons. In addition, Indians last week were carefully negotiating the possibility of a, assuming the bilateral agreement with Pakistan because of the Sino-Pakistan pact.

The U.S. postponed the \$4.4 billion loan to Pakistan when it learned that the agreement with China had been signed. Funds from the loan were to be used for expansion of the airport at Dacca in East Pakistan.

Later this month, a Soviet air delegation is scheduled to meet with Pakistan officials to negotiate an agreement that will permit Aeroflot planes to overfly Pakistan territory on the route between Moscow and Jakarta, Indonesia.

CAB Rulings Reflect Helicopter Policy

Washington—Civil Aeronautics Board's determination to control and reduce safety problems for helicopter operations has been demonstrated in two recent Board actions without approval of new helicopter operations to those able to function without subsidy and

New Francisco and Oakland Helicopter Airlines (NFOH) was recommended for relief from certification for its CAB Executive Herbert K. Brown, previously on grounds of safety. He had already been suspended since then and appeared likely to become profitable without subsidy.

Earlier, the federal CAB had dismissed a three-year-old case investigating the need for a scheduled helicopter operation in the Washington-Baltimore area. Annual cost of the operation would have been \$2 million annually, according to a higher estimate with less little potential for operation in less than six years.

Explaining its certification of scheduled helicopter operations in New York, Chicago and Los Angeles, CAB said its purpose has been to encourage the development of money which would be a source of transportation rather than to assist an unprofitable service. Supporting the earlier findings of an examiner, the Board said that the routing helicopter operations in the three cities is adequate to supply air service.

Earlier, between the cities of Washington and Baltimore, plus the capacity of Washington National, D.C., International and Friendship "with or without subsidy eligibility" was considered in the investigation. However, the eight applicants made it clear that they would not accept certification without the protection of subsidy funding.

Executive Brown emphasized NFOH's unique geographical location, high utilization of equipment and strong public support, and concluded that the carrier was unlikely to become an subsidy dependant for its operations.

NFOH has been operating for about 18 months, but a higher revenue and daily utilization rate than any of the three scheduled helicopter operations. Brown said it could pay its route passengers and a 49¢ each as compared with 29¢ by Chicago Helicopter Airways, 35¢ by Los Angeles Airways and 40¢ each by New York Airways. Average stage lengths for flights are 7 to 7.7 mi. shorter for NFOH than the others, providing a daily utilization rate of 5 to 12 mi., compared with the next highest rate of 5 to 2 mi. for New York Airways.

Concorde Mockup Unveiled

Full-scale fuselage mockup of the Anglo-French Concorde supersonic transport reveals details of the aircraft nose drooped to cover pilots' windshields during approach flight. (Note nose in flight position opposite page.) Close-up views of nose section (this page) show nose rails retracted for use and disused for approach flight and partially extended. Side windows are made of quartz. These first photos of the Concorde mockup were made at Bristol Aircraft production plant in England. Bristol is a division of British Aircraft Corp., partner in the SST program with Sud Aviation of Toulouse. Mockup controls will include wings and tail section, under-panel glass. Two Boeing prototypes will be completed in 1968, one in England and one at office in France. The Concorde mockup at Bristol shows interior arrangement with low dorsal seating in main passenger compartment. The capsule will be fitted with 74 rows of seats (AW Jan 7, p. 10). Floor-to-ceiling height is 7' 11" and side is 15' 11" wide between main seats.



Northeast Case Pressure Seen as Threat

By L. L. Doty

Washington—Congressional pressure to action the New York/Florida route to Northeast Airlines is being viewed here as a serious threat to the U.S. legislation system.

Last week, legislation that would grant permanent certification to that line that have operated under temporary authority since 1957 was introduced in both the House and Senate by New England legislators. Since Northeast's New York/Florida certificate is the only temporary domestic trunkline authority currently in effect, the legislation was obviously drafted for the sole purpose of ousting the CAB from action Board decisions in the Northeast renewal case (AW Sept. 3, p. 11).

The congressional drive to authorize the CAB on permanent certification is not unprecedented. Congress crossed the CAB when it passed legislation in

1951 to give local service routes permanent authorization. It subsequently modified an earlier Board law, but planning agencies watch 25% of the local routes route, status under temporary authority to allow for route adjustments that might be required by economic pressure.

Kath, Congress again passed legislation over CAB objections authorizing permanent certification to Staten Island carriers in both cases industry officials expressed doubts over the regulations of the congressional action.

The current move is considered particularly serious because the bills are aimed at restricting a single transportation problem affecting a single region. Although the proposed bills are designed to action Northeast to the Florida market, the move appears opposed to provide the New England taking contractors with assurance that even attempt will be made to sustain regional services within New England.

Rep. Markings Keth (D Mass.) reportedly stated that if there are no Florida routes, there may well be no Northeast.

Bills call for an amendment of the Federal Aviation Act of 1958 in order to provide the permanent certification of Northeast's southern routes. It is clear in that if the legislative drive is successful, other similar routes permitted by regional interests would be encouraged that eventually would prevent the CAB from opposing local as a regulatory agency.

It could encourage a disappointed candidate for a route to use congressional influence to change a CAB decision in his favor. It could expand congressional interference in the affairs of the CAB, which was established by Congress as a quasi-judicial body.

Crested concern is that the legislation could set a precedent that would

bring the operation of a regulatory agency into the political arena. The prime purpose of the regulatory system is to provide regulation of an industry in the public interest without any political considerations.

CAB Chairman Alan S. Boyd spoke vigorously on this point during testimony given before the House Committee Subcommittee.

He stated that the regulatory system is a joint system set up by Congress and suggested that if Congress did not feel it was a good system, Congress should change it. Throughout the congressional travel over the Northeast decision, Boyd has held firm to his belief that the Board acted properly in the case and has shown no signs of moving on his role in the decision despite the heavy pressure exerted on him.

Temporary certification was authorized under the Federal Aviation Act to permit the CAB to fulfill air transport requirements in an interim basis in most annual transportation demands.

The Board, however, has used the temporary certificate more often in cases

where financial success was in doubt, as in regional scheduled helicopter operations, seasonal routes, supplemental services or, usually, in local service and intra-Alaska and inter-Alaska services. On the point, Malcolm A. MacIntyre, president of Eastern Air Lines, said this:

"There has been, undoubtedly, a tendency to use the temporary certificate device for interim authorizations when there were doubts as to the economic feasibility of the route. Temporary certificates ought not to be granted on that basis. The requirements of public convenience and necessity should be proved, judgment exercised fairly, and disposition of applications made soundly. If permanent certification is not believed to be warranted on economic grounds, a temporary certificate should not be granted in the hope that 'things might turn out all right'."

MacIntyre agreed that Northeast operated under a hardship as a result of its temporary certificate in the New York/Florida market, but stressed that resuming carrier operating with a per-

manent certificate also suffer from the uncertainties of the temporary certification. He noted that the permanent-certified carrier experiences a direct loss of business with a loss of revenue.

"As it suffers losses and seeks first to bring upon reasonable terms, it is undoubtedly confronted with the question of whether the temporary certification of the third carrier will be continued," he said. "That makes the problems of the permanent-certified carrier more analogous to the starting of the temporarily-certified carrier."

In a special statement, Rep. Kath emphasized that the bill he sponsored was not intended to have an influence on other pending administrative or judicial proceedings. He said that the primary concern is the public interest but added: "I cannot believe that it was the intention of Congress to have an action which has effectively served New England and the East Coast... for now this action may, demand this operation by a Board in Congress created to promote the best possible air passenger service."





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Ilyushin 62 jet-prop transport and key factor for Russia in aircraft and playgrounds are products of plane that will build IIG

Ilyushin 62 Tests Aim at 1965 Route Service

Soviet Russia's Ilyushin 62 156-passenger jet-mounted jet transport is expected to enter service with Aeroflot in 1965, probably starting with flights on internal routes and later on flights linking Moscow and Havana non-stop. First flight is being used for handling and systems tests; another will be assigned to automatic flight control and landing system checks. Flight test was scheduled in the passenger cabin of IIG-2 is expected flight by Air Commanders A. N. Dron. Details are expected in Moscow. Exports of the machine is shown below on the way to Vladivostok, near Moscow, following a test flight. The IIG-2 will be a program of 1,400 hp of development tests before being turned over to Aeroflot by the Government Test Center. Chief test pilot for the project is Vladimir Kabanov.



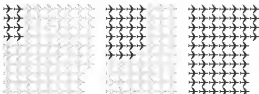
What's the score on fan-jets?

The American Airlines fan-jet story

There seems to be quite a bit of talk about fan-jets these days. It isn't surprising.

Fan-jets are 30% more powerful than ordinary jets.

They take off faster and they climb faster.



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Fan-jet fan 5 of them are fan-jets.

American Airlines fan-jet fan-jets.

[Fan-jet engines take in twice as much air as ordinary jets. This gives the thrust twice as much body.]

There's just one thing about fan-jets. You may not get one. There are 24 airlines in this country. Yet only 2 have fan-jets on every jet flight.

One is Western.

The other is American. [We call our fan-jets Astrojets.]

The chart above will show you how many fan-jets the 3 major airlines have today.

It will also show you which airline guarantees you a fan-jet on every jet flight you take.

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Airline Income and Expenses—June 1963

	OPERATING REVENUES						Total Operating Expenses	Net Profit (or Loss)	
	Passenger	Cargo	Other Non-Mail	M & P Pass.	Passenger Satellites	Freight			
DOMESTIC TRAVEL									
American	41,304	2,222	124	753			43,403	36,640	4,100
Boeing	6,274	278	112	599			7,467	6,117	403
Continental	4,779	242	119	599			5,739	4,732	100
Delta	16,567	1,020	112	350			17,959	15,986	1,239
Eastern	34,309	1,173	368	423			36,143	34,915	1,200
Northwest	8,113	483	49	574			9,219	7,722	1,332
Southwest	3,153	112	87	27			3,379	2,494	1,209
Texas World	2,202	612	27	27			2,968	2,494	1,209
Trans World	20,294	1,384	320	427			21,895	20,439	1,209
United	20,489	2,846	444	1,450			24,809	22,762	1,209
Western	7,436	334	87	72			7,929	6,563	1,209
Domestic Travel Total	195,119	10,126	1,740	6,097			213,082	176,299	13,400
INTERNATIONAL									
American	812	34	52	8			836	456	93
Boeing	727	30	42	48			847	487	93
Continental	417	36	4	1			458	432	101
Delta	218	32	1	1			252	248	93
Eastern	2,916	184	1	83			3,184	3,050	194
Northwest	354	413	11	88			866	739	65
Southwest	5,479	413	329	888			6,609	5,352	264
Texas World	1,232	282	114	129			1,757	1,748	93
Trans World	42,431	4,819	4,264	2,656			54,170	42,795	4,201
United	891	71	466	1			1,429	1,313	238
Western	15,245	947	314	1,120			17,626	16,448	1,199
International Total	72,103	3,110	5,466	6,376			87,055	76,389	10,400
OTHER AIRLINE									
American	1,234	118	28	27			1,407	1,327	164
Boeing	727	12	12	4			755	693	48
Continental	484	33	11	17			545	532	81
Delta	814	59	24	17			914	1,421	94
Eastern	274	45	14	19			352	889	73
Northwest	1,872	28	12	22			1,934	1,814	24
Southwest	1,733	104	26	37			1,899	2,314	124
Texas World	1,264	73	14	18			1,369	1,347	73
United	473	22	8	10			513	513	93
Western	1,239	27	26	26			1,318	1,318	62
Trans World	773	47	54	59			933	1,344	28
United	410	37	14	33			494	779	22
West Coast	448	24	12	7			491	445	48
Other Airline Total	10,985	507	263	240			11,995	12,020	581
ALASKA & HAWAIIAN									
American Airlines	271	26	371	28			696	694	29
Alaska Airlines	1,091	13	13	12			1,119	1,119	126
Delta	490	8	13	5			516	494	45
Eastern	20	14	49	7			90	90	129
Northwest	719	30	30	4			783	773	164
Southwest	129	2	12	7			150	99	164
Trans World	182	80	34	65			359	311	11
United	144	44	97	38			323	292	111
Western	111	2	1	5			119	119	111
West Alaska	300	37	147	104			688	688	111
Alaska & Hawaiian Total	3,463	227	746	427			4,863	4,863	580
OTHER AIRLINE									
Chicago	21	1	1	2			25	123	42
Los Angeles	17	16	5	12			50	194	48
New York	201	4	8	4			217	357	13
Other Airline Total	239	21	14	18			292	674	103
CARGO & OTHER									
American					Not Available				
Boeing	35	1	2	1			39	41	1
Continental	107	2,507					2,614	2,234	129
Delta	735	468					1,203	1,261	1,219
Eastern	1,023	1,024					2,047	1,919	1,119
Northwest	35	1,024					1,059	1,059	1,119
Southwest	35	1,024					1,059	1,059	1,119
Trans World	35	1,024					1,059	1,059	1,119
United	35	1,024					1,059	1,059	1,119
Western	35	1,024					1,059	1,059	1,119
Cargo & Other Total	35	5,070	6,100	363			8,578	8,516	1,190
Industry Total	263,098	31,167	14,963	11,591	6,413		325,232	300,248	21,480

* Airline results reported as of second quarter

* Airline profit reflects freight rates as of date

Prepared by Ray & Ray

American Engineers Still Ask Pilot Rating

New York—Principal roadblock to negotiations between American Airlines and its flight engineers toward a new contract still is whether the engineers will receive *own-on-pilot* ratings.

American's chapter of the Flight Engineers International Assn. insists that commercial and instrument flight ratings for engineers are vital to the thing they want: *own-on-pilot* ratings.

Flight ratings are especially important now to the engineers, because they are being provided to flight engineers on Trans World Airlines and Pan American World Airways. For American's engineers to continue within the ratings contribution to an organization is the qualification of individual FEAs men and locks them out of the spread wing industry itself toward their own pilot-based cockpit crew, according to spokesmen for the engineers.

"If American offered us the same contract as that signed by TWA and Pan American, we'd be satisfied," says John Schwartz, general counsel for American's engineers.

Then, he, however, American has refused to finance the engineer pilot rating, which would cost approximately \$10 million. If anything, the airline's attitude has softened since the signing of a new contract with its pilots (AW July 15, p. 19).

Flight engineers originally conducted joint contract negotiations with American's pilots, and were capable to making the commercial and instrument ratings. But this was conditional on the engineers being occupied with the Air Line Pilots Assn., with job security provisions that would make up for their not being pilot-rated.

However, ALPA refused ratification of the proposed contract because the engineers, without the commercial and instrument ratings, wouldn't qualify to do the pilot-rated job. In fact, they were not even cockpit crew. All there is a three-man crew. ALPA had, even in, qualified pilots.

Consequently, when the pilot contract was signed, the flight engineers were not a part of it. And the company refused to negotiate with the engineers separately, questioning whether the FEAs has the proper licensing agent in view of the cockpit part pilot-engineer negotiating, unrepresented.

This question was raised later by a U.S. District Court ruling (AW Aug. 10, p. 81). FEAs and ALPA, both brought suit to compel American from dealing with the Allied Pilots Assn. denied to American pilots. The court decided that Allied was precluded in claiming to represent American's pilots, but upheld FEAs as the engineers' legal licensing agent.

The pilot's contract has brought new problems affecting the FEAs contract.

demands. Pilot's own granted reduction in monthly flight time separate, from 81 to 75 hr., and some of added retirement and insurance benefits. These concessions were, initially, expected by American to induce the pilots, making toward the engineers' pilot training for the engineers.

Now, the engineers want the training, and otherwise note that if the airline grants it, the effort would be the same as giving it twice in a row of the cost to the pilots.

Flight engineers, who have been without a contract since May 1, are also asking for a retroactive 9% wage increase for each of the last two years, which they say is to "compensate for increased wage increasing provisions of the former contract." They have also asked for the same flight time reduction as granted to the pilots.

The job security question the engineers feel, can be solved if American will grant the Passenger Committee recommendations of Oct. 1964. Besides granting flight training for engineers and pilots, the engineers want, in the "third suit," the Passenger group also proposed one union in the cockpit.

"We're willing to talk with the AL

and pilots about joining them," Schwartz says. "But we want our contract first. That's the way it was done on TWA and Pan American, where the engineers secured their agreements and then began talks about going into ALPA."

One thing that American wants is a single cockpit union. But the three problem of the engineer pilot training remains the roadblock.

Flight engineers are hopeful that American's contract of proposed J. D. Jerald (AW Aug. 12, p. 19) can help amend the stalemate. Jerald was formerly head of industrial relations for Eastern Air Lines, and was a pilot, then in offering Eastern's new terms, the Passenger recommendations. However, Eastern's engineers, unlike those of American, rejected those terms and Eastern evaded a long strike, even fully broken when pilot training as flight engineers took in the third suit.

The issue of Eastern's experience is critical to both American and its engineers. Eastern has an estimated \$10 million in the strike, and its engineers, although still protesting, have little hope of ever obtaining a settlement.

Engineers at American aren't talking of a strike, and reject general agreement now that their representation rights have been upheld. But Schwartz did say that if this with the engineers has a system, the National Mediation Board.



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Aeroflot Replacing An-2s With An-14As

Moscow—After six years of waiting, Russia's Aeroflot is beginning to put its two-engine Aeroflot short-haul transport to regular service to replace obsolete, single-engine An-2 biplanes.

The new craft, designated An-14A, is a modernized version of the An-14 which was first introduced in 1957. Both planes are known as the "Pobeda" (Victory) Bus.

Development of the An-14 took so long that Soviet inspectors a number of Czechoslovak, Arab and Mexican light planes to operate service as locally intended for the Victory craft.

Most significant modification in the An-14A is substitution of 100-hp, M-14A1 solid engines. The An-14 had 200-hp, M-14B1. When spun out, the modification was to cost \$100,000. Aeroflot planes under the An-14A are to be of about 14 ft. in size on one engine and more than 17 ft. on two, with high engines.

The An-14A, once in service, promises a 1,320 ft. of climb in 4 min. 30 sec. at speeds of 206 kts. mph. Range with a 1,215 lb. payload and a 1-hr. fuel reserve is 835 mi.

Six passengers are carried on the non-pressurized cabin and the seventh sits in the cockpit next to the pilot. Special baggage compartments are in the tail section of the fuselage.

An-14As (which destroy kills) loaded with mixed phosphoric compounds at 295 ft. and 100 ft. in the Russian air. This compares with 689 ft. and 198 ft., respectively, for the An-2 biplane. (Which will handle distances for the An-14A are not almost as high as at 21 ft. 15 mph head wind. Douglas G. K. Anderson had hoped to reduce the An-14A's climb rate to 10-12 ft. min. favorable conditions.

The An-14A can be converted easily for exclusive use as a cargo plane. East loading dock makes the craft especially suitable for paratroop jumping.



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CONVOYERS still are used extensively in Greenland to transport personnel and equipment and to guide polar ships through icy, shifting field waters. Helicopters are regarded as highly replacements. Back of the cockpit is a rescue mooring.

Helicopter Potential Cited for Greenland

Copenhagen, Greenland—Planners struggling with Greenland's economic problems in this capital city are beginning to regard the helicopter as the most promising form of Arctic transport since the dog sled.

These officials have the job of moving Greenland from the Stone Age to the Atomic Age so the standard of living on the ice island—the world's largest, with 548,000 sq mi—will compare favorably with Denmark's.

But aside from that general objective, approved by the Danish Parliament in 1973 and formalized in 1975 by a constitutional amendment that made Greenland a full equal with Denmark, there are few specific guidelines for the planners to follow. Therefore, they are willing to try new approaches.

Two-Turbine Helicopters

New twin-turbine helicopters, with their greater safety and lower operating costs, make sense to the planners. Greenland's severe winter forces ships out of the watersways early, isolation on ice makes air both imperative and the upper Casar PRF-5A, Boeing Catkins and de Havilland D-6A Beaver and U-1A Otter, will very much in use here have their limitations. Since no fixed-wing, amphibious aircraft capable of landing on snow, water and land) is necessary as yet, the Danish government has turned its attention to rotary-wing aircraft.

Denish government officials, including representatives of Scandinavian Airlines System, already have approached U.S. helicopter manufacturers, and have invited Sikorsky to use the S-61N twin-turbine amphibious model and to license Vertol to make the 1071H. Danish operators of the amphibious helicopter produce range from three to seven aircraft. There is a possibility that some

will be used by the army and air force rather than in Greenland.

Just when the helicopter decision will be made is uncertain. Hans C. Christensen, general manager of the Royal Greenland Trade Dept., predicts helicopters will be in use in Greenland "within three years." With Denmark already spending about \$29 million annually in Greenland, the helicopter on thousands may have to stand in line for funds.

Regardless of when helicopters begin to serve Greenland, their operation will push back the horizon for rotary-wing aircraft a little farther. The all-terrain, passenger-carrying services envisioned for Greenland would be the most rugged in the world, both in terms of

point-to-point distance and weather conditions. It also will provide experience, if Danish officials have their way, in the use of the same helicopter for cargo on some runs and passengers on others.

New Opportunity

One U.S. helicopter executive sees the intended use of helicopters in Greenland and their use in Pakistan as "an opportunity just beginning to crack" for the industry. Pakistan (Islamic Republic of) announced in January that it was buying three Sikorsky S-61Ns to take passengers from Deera, the capital of East Pakistan, to 20 towns and villages.

The helicopter service is slated to begin in October.

In language reflecting Denmark's similar hopes for Greenland service, Air Commander M. Nørh, managing director of Fokker's Greenland Airlines and "the helicopter will bring about a revolution in the communications system of the area and will cause an upsurge in the commercial economic development of East Pakistan." PLAN S-61Ns will carry 25 passengers and cargo.

Operating Costs

Just how rapidly and safely helicopters are accepted in a field to developing primitive areas depends largely on operating costs. Target for the Sikorsky S-61 at 4 cents per seat mile. Industry officials hope the next generation of passenger helicopters will halve that figure, bringing the cost to as low as 3 or 4 cents a seat mile.

Such a lowering of operating costs has opened appeal for these Danish officials, who are now concentrating on Europe. Greenland supplied the year-round but who hope some day to turn

Modernization Rationale

Copenhagen, Greenland—Denmark's dual administrative official in Greenland publishes his government's rationale in the island's mode of living by saying, "Once you get a new gun, you want to go back to the bow and arrow."

M. O. Christensen, dual administrator for Greenland, remarked that many Greenlanders would be happier to remain as primitive as the Eskimos were than to be moved to the modern of the land. But he said the balance of efforts in Greenland was no doubt for modern living techniques and the migration of units northward when the northern part of the island warmed slightly. That modernization because the only alternative to serious hardship or starvation during the winter.

Now the Danish government is trying to persuade Greenlanders to leave their hunting encampments and settle in villages where education, medical aid and even wage markets are available.



Like ordinary life, theater goes on in GDR. In this case, it's a movie theater in Rostock. The film is "The Great Escape" (German title: "Der große Durchbruch").

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their situation to trainees. The dream is to let Scandinavian Airlines (SAS) fly tourists from Europe and the U.S. to its polar landing field at Sande Strand on the west coast of Greenland, where SAS maintains a modest base.

Tourists would be flown by helicopter to the primitive, picturesque villages along the west coast.

Halsbørg, on Greenland's west coast, is such a village. The first thing a motorcade approaching the village by water is greeted: colorful cottages, among the doll houses on the rocky hills rising from a harbor filled with boats and yachts is colorful in those on a scenic coast.

Contrast Noted

A closer look shows the contrast of the old and new which by Denmark's decade of effort to modernize. Green Island-Greenland natives, who are decidedly more rather than less, are working in the fish factories, fish drying in back yards, in the primary school buildings while the women of the house hold work over a modern wall, a horse-drawn shaft, built along close. Follows trees, fishing in the shallow of a modern apartment house occupied by both natives and Danes. Lush fields, recently strong from the dairy coast, to make war for a sheep. Volkmann's bus, Greenland women, and many years out of a primitive hunting scene, carrying cod fish home for supper in a plastic shopping bag.

All the best place at surprisingly pleasant temperatures of about 50°F. The Arctic sea does not fully set in summer but days only look enough to let the sunbathers along Halsbørg beach, over a first shadow beach, over the cold blue fjord. Norwegian tourists, Greenland recently found the same scene reported in various degrees of beauty in other places such as Solberg, Høpner, Egeboer, and Fjellbøl.

The last village has 1,500 people and 3,000 dogs and is the birthplace of polar research. But look off and back into the fjord. The villages are so large that they fill the face in the ship from there—a river which some polar ship captains continue to prefer over sails.

In all this, along with the presence of the sea, sailing and trips to the ice cap which cover 90% of Greenland to a depth of 10 miles or two miles, enough to draw tourists to Greenland? In a, in some Danish cities, as under the Arctic Basin.

It is not only to tell, but it is obvious that Greenland's future is being shaped significantly by nature. The aircraft, perhaps more than any one tool, is considered vital to Greenland's progress.

East Germany Reincorporates Flag Carrier; Name Is Changed

German-East German government, briefly embracing victory, in its West German counterpart in the post World War II dispute over the right to the flag carrier under socialist state.

The action, classified the carrier into a former subsidiary, Interflug Gesellschaft, East German government. Apparently it will be followed by further attempts to push states beyond the Communist bloc.

Previous attempts to obtain trading rights, particularly in Eastern Europe, have been blocked primarily by the carrier's resistance upon using the name Deutsche Luftfahrt, the daughter of German's post-war flag line and the one adopted by West Germany's national airline.

The carrier's carrier's efforts to enter west to reach of hard currency and prestige have been hindered by its status in each country by the West German airline. Recently, it was provided for the reorganization of the carrier's aircraft, possibly to be followed by the carrier's efforts to reach the west.

East Germany's latest move, detailing its own Luftfahrt, is reported to be followed by new efforts to 8, in the west. It was announced only three days before Interflug formally took over the East German Luftfahrt's route structure as Sept. 1.

According to West German officials, Interflug, itself, has its baggage in other attempts by the East German government to purchase the west. The carrier, on the one of the name "Luftfahrt," the government in 1975 established a subsidiary in hopes of at least gaining a charter flight service through Yugoslavia—which was denied West Germany's claim to Albania and Vienna.

The carrier, however, prohibited itself, alone. Now, in Interflug takes over Luftfahrt's three Soviet Division 11-25 (Tupolev) and 30 (Ilyushin) 11-14P (Tupolev) transports, the German at least has carried out the legal battle over its airline's name.

It is doubtful if the West German government would grant to East German carrier the right to serve its territory under any name. With some dramatic, however, Interflug should be capable of reaching its hoped-for destinations in the west without overflying the Federal Republic.

East German Deutsche Luftfahrt, which began with a launch in 1976 as a direct challenge to its western com-

petitor, even to the adoption of an almost black-and-yellow color scheme, has moved a policy economic path into its struggle.

Interflug, under socialist, Berlin Leipzig and Berlin Dresden—have been less successful in a country with a good and bad airline system and only 41,800 sq. mi. of land area. Its route includes East Germany to west German capitals in Moscow and Warsaw have not found much better than its informal route.

A seven-year plan hopes in 1978 predicted that the carrier would have a fleet of 170 aircraft by 1985. Instead, the fleet has remained relatively stable at about 50 with the majority of those still aircraft used in such side duties as crop dicing.

Swissair Caravelle Crashes Near Zurich

Geneva-Swiss federal aviation officials are investigating the crash and resultant explosion of a Swissair Caravelle accident near jet transport shortly after takeoff last week from Zurich's Kloten airport on a scheduled flight to Geneva.

Investigators said they appeared to be a fire in the tail section just before impact.

All 74 passengers and 6 crew members aboard died. The crash marked the first fatal accident in which a Caravelle has been involved since the aircraft went into scheduled flight in 1959.

A total of 145 are now in service with 18 aircraft.

Swissair, which registered the first Swissair Caravelle since June 1974, when three passengers were lost during the ditching of a Caravelle 246 in the English Channel after the aircraft had been involved in two crashes.

Swissair officials said and said that contact with the aircraft, which was on a flight to Geneva and Rome, was lost 10 min. after takeoff. As the aircraft crashed, it had 11 passengers and the crew said that there had been no indication of any trouble.

Residents of a small village near Zurich subsequently reported that the aircraft had crashed in the area on a hillside. The village, Wetzikon, said the fire appeared to have broken out in the tail section before impact which triggered off an explosion of the Caravelle's fuel tanks, destroying the aircraft.

AIRLINE OBSERVER

► Presence of Civil Aeronautics Board observers at the International Air Transport Association traffic conference in Salzburg, Austria (AW Sept. 2, p. 20), could deprive U. S. carriers of flexibility in negotiating rates and fares. Some Board staff members feel that TWA and Pan American were not as outspoken for lower fares at the Canadian conference as they might have been, but the witness insists that they were left into supporting a higher fare through the necessity for compromise in the conference. In a letter to all U. S. IATA members, the Board has requested the assurance that fares be reduced "substantially." With government observers watching over the shoulders of U. S. airline delegates to make certain that the low fare position is rigidly adhered to, compromise bargaining will be difficult, and some a number of foreign carriers will react the same for sharp fare cuts, a dead locked conference may result.

► Civil rights language in the federal aid to airports act is drawing congressional criticism of the bill program. Passed by a Senate aviation subcommittee, a bill to renew the act for three years is being held up by a House aviation subcommittee headed by Rep. John Bell Williams (D-Miss.). Civil rights language has been in the act for several years, but the Federal Aviation Agency now considers it a privacy requirement that must be met before funds can be allocated to any airport.

► Local airline airlines have reported impressive gains in the number of passengers carried during the 11 month period June 30 compared with the same previous period. Of the 11 local service carriers, only West Coast failed to register an upsurge in traffic. Biggest gain was reported by Piedmont, with a 39.7% increase in traffic, followed by Bonanza, with a 34.4%; gate Southern showed a 24.9% increase; Frontier 21.4% and Coast reported a 20.3% improvement.

► Landing fees to be raised during forthcoming negotiations on the revision of the bilateral air transport agreement between the U. S. and Canada (AW Sept. 3, p. 20) will be trans-shipment charter operations between the two countries. Canada claims that 158 U. S. charter operations are licensed to serve Canada while only 19 Canadian carriers are authorized to operate into the U. S. Canada holds that a heavy volume of cargo has resulted and will demand an adjustment of the balance.

► United Air Lines' single-class service, expanded recently to a total of 71 daily flights (AW Aug. 20, p. 36), continues to meet stiff opposition from United's principal competitors. American, Continental and TWA. American appears to be leading the fight and last week, bluntly announced it had no plans to downgrade single-class service in long-haul markets. American also criticized Continental's domestic service configuration as grounds that there is not sufficient reason to provide service in three separate configurations.

► Legislation has been introduced in the House by Rep. Roman C. Pucowski (D-Ill.) that would prevent the operation in the U. S. of supersonic transports that produce overpressures exceeding 3.5 lb. per sq. ft. as the aircraft descends beneath the flight path of the aircraft. Pucowski and his legislative aides are anxious to keep the U. S. and other nations to give more control to congressional action.

► Administration concern over the "balance of payments deficit" is reinforcing the aviation industry. U. S. tourists who last year spent more than \$1.4 billion with foreign airlines and countries have accounted for most of the deficit, the government claims. However, industry observers point out, little has been mentioned about the fact that in the same year this deficit was offset by the export of U. S. manufactured products, payable in dollars. Increased travel by Americans as a means of international trade has been responsible for the improved financial health of both U. S. flag carriers. Now a resolution has been introduced which Congress should Americans to stay home in 1965, in a move of reducing the balance of payments deficit.

SHORTLINES

► Atlanta Airlines showed a 15% increase in the number of passengers carried during the first six months of 1965 compared with the same period last year.

► American Society of Travel Agents has asked the International Air Transport Association for a substantial reduction of international fares. Specifically, the group asks lower special discount fares, lower off-season fares, a year-round maximum fare and abandonment of pre-rate charter and affinity group fares.

► CSA, Czechoslovakian Airlines, which celebrated its 40th anniversary July 28, has reported its aircraft schedule for next week runs totals more than 57,266 mi. CSA serves 35 cities and 36 countries in Europe, Asia and Africa and operates flights into Cuba.

► Irish International Airlines generated a 60% load factor on combined transatlantic flights during the three months ended June 30. Workload load factor during the same period was 85%.

► National Airlines and last week that of records, it can choose 323 North east Atlantic airports within the next six weeks. National said it could not hire pilots because 45 National pilots are currently on furlough.

► North Central Airlines has been awarded a 100,000 contract by the Agency for International Development to provide managerial and technical assistance in Lloyd New Belorussia Airline of Belarus.

► South American Travel Organization has been formed in Miami to develop common efforts to promote travel to South America. Organization has outlined an array of services, travel agents and hotels in hopes of increasing U. S. tourist expenditures in Latin America. Last year, only 7% of the U. S. tourist dollars were spent in South American countries.

► Western Air Lines has added three daily coast-to-coast flights to its current Thriftair service between San Francisco and Los Angeles, bringing the total to 24. An average of 4,100 passengers are being Thriftair daily, an increase of about 100 passengers a day since early July. Western reports a load factor of more than 70% on the flights, which are operated with 32-passenger Douglas DC-8B transports.



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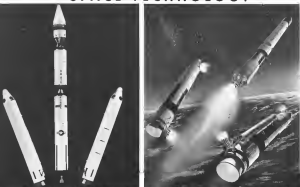
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EXPLODED MODEL OF TITAN 3C (left) shows solid booster stages, first and second stages of the core, standard payload shroud, Atlas-Agena upper stage, solid booster separation with two boosters of astronautics on each booster.

Air Force Stressing Operational Economy

By C. M. Flattner

Los Angeles—Anticipated operational economies of the Titan 3 launch system are providing Air Force with an argument for continued support of the booster system as a national launch vehicle.

The projected low unit-booster costs, combined with a potential mid-trim cost cap, suggest lower launch-weight vehicles to establishing payloads into synchronous orbits, while the Titan 5 is a strong contender for payloads of other government agencies as well as for USAF's anticipated space defense role.

Complete sales of 10,000 1964 funds—\$524.6 million—already has been announced from Defense Dept., which has agreed to spend five billion in the program. This has been interpreted as an indication of greater confidence in the Titan 3 program, which was funded for an estimated \$340 million in fiscal 1965 and about \$16 million up to and including fiscal 1967.

The Titan 5 program is in the tenth month of a 45-month research and development program, which began Dec.

1, 1967. The first scheduled flight test has been set for August, 1968 with the launch of a Titan 3A (modified Martin Titan 2 plus strap-on). The first Titan 3C (Titan 3A plus two 120-in.-dia solid-propellant strap-on boosters) will be launched in the early summer of 1969. The Titan 3A with a payload capability under the Atlas-Agena is viewed largely as a stepping stone to development of Titan 3C. Its main shroud is considered a bonus to the Titan 3 program. However, the expected short count-down time, rich shroud, common and 10-ft-dia payload attachment during are expected to make it an attractive vehicle for payloads within its capability.

The projected operational economy of the Titan 3C booster is expected to make it highly competitive with other launchers such as National Aero Services and Space Administration's Saturn 1 and B1 boosters.

Results of recent Air Force studies, comparing expected operational costs of the Titan 3C booster with other launch vehicles, shows that:

- An approximate 50% increase in the cost of an operational Titan 3C is an

expected, level on limited production of eight flight vehicles for the X-22 (Delta Four) program. Air Force estimates that for a comparable production run, the unit cost of a Saturn IB would be approximately double the Titan 3C cost. Remaining costs do not include research and development costs for the launch facilities and equipment produced during the research and development program. Differences in cost of solid and liquid propellants and related system complexities are generally negligible for the cost differences.

• A savings of \$1 million for Titan 3C could be achieved with a production rate of 75 boosters per year for five years (AWJ, July 22, p. 72). This compares with \$15 million for a Saturn 1B and \$11 million for Saturn 1, both based on the same production rate. This \$1 million figure also is consistent in comparison with the cost of an Atlas-Centaur.

Air Force spokesmen point out that given a high production rate, and a 50 million-psi cost reduction as a production goal could be met, perhaps enough savings through reduced manufacturing costs to make the Titan 3C



TWO VIEWS OF THE TITAN 3C STRAP-ON (above) show control and guidance module at the top and power module at the bottom of the strap-on.

Of Titan 3 Launch System

competition in price with the Atlas-Agena.

Cost of an Atlas-Agena is estimated at approximately \$2.5 million.

The Air Force studies, completed last spring on the Titan 3C system, were undertaken in spite of a series of related technical and cost questions generated by DOD. Defense Dept. has consistently indicated that support for the Titan 3 program depends on economical and efficient program management.

One question dealing with the effect of cancelling the Titan 3 program and transferring the Saturn program was explored by the Air Force. In reply, it was pointed out that neither of the Saturn launchers had the performance capability nor the economies of operation of the Titan 3C since this program was developed to support the Apollo program and was not designed to carry a bulk weight of payload.

Neither of the Saturn vehicles has an upper stage with a multiple restart capability. (5-IB has a single restart capability). Also, it was pointed out that the Saturn vehicles could require as many modifications at payloads such



as lifting bodies were considered. As its present configuration, the Saturn 1B has no means to be used to launch the X-16, because of unusual stress characteristics during the boost phase.

Payload capability of the Saturn 1B (57,000 lb to 100,000 lb) is not as great as that of the Titan 3C (25,100 lb to 100,000 lb). Instead of the Saturn 1, it is estimated at 18,000 lb, while the Titan 3A can lift 5,800 lb to low earth orbit.

A Mission Space Flight Center study, however, is investigating a reusable upper stage for Saturn 1B and Saturn 5 boosters. The upper stage, known as the S-4 stage, is called a multi-restart vehicle (MNRV) and is being studied primarily to support lunar logistics payload delivery. It would be powered by two thrustable RL 10 type engines.

Such an upper stage could provide the Saturn 1B with synchronous orbit and other transfer capability. The MNRV study is a relatively small effort though and is not part of an officially sanctioned research investigation.

Meanwhile, NASA is showing increasing interest in the Titan 3 program



TITAN 3C MODEL in assembled stage-Titan 3C. Details of large solid booster separation vehicles are shown for the first time. Two boosters of four rockets are used on each of the boosters.

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VERTICAL INTEGRATION BUILDING (VIB) has four assembly bays. Transporter (right) uses diesel engines for power. General requires most new assembly vehicles from assembly to launch site, emphasizing the need for dual systems.

and all engine sections have been tested on the launch system by a special Air Force team. NASA planners are reported very interested in the Titan 3C Launch Research Center recently sent out a contract change notice to Marshall Guiding Research Laboratory (MORL) study contract (AW Aug 10, p. 37) adding Titan 3C to the launch vehicle list.

The Titan 3C also is being considered as a booster for the advanced logistics transport (AW July 29, p. 55). Brig Gen Joseph B. Blumstein, director of Titan 3 program at USAF Systems Command's Space Systems Div., underscored the importance of booster test when he noted recently that about one-half of the funds expended for space projects are for launch vehicles. The history of the Titan 3 program is indicative of an effort to provide a vehicle tailored directly to mission operation as a national basis.

Study Approval

Early in the program, DOD approved studies leading to development of the system after favorable recommendations by the Large Launch Vehicle Planning Group, a joint NASA-DOD board. The board suggested development of the solid-liquid Titan 3C as a standard national launch vehicle, as well as the Saturn 5 Apollo vehicle and the M-1 engine.

The development approach employed by the Air Force, at DOD direction, was to define completely the system on paper prior to starting a hardware program. This resulted in a 32-month study, called phase one which began in October, 1961. During this period, major of making a minimum of four 1% to 2.5% over their cost. For adequate performance, the average reaction time is expected to be about 75% with an expected range of approximately 2 to 12%.

The Titan 3 system, an Air Force project to off air, consists of two ve-

hicles—5 Titan 3As and 22 Titan 3Cs.

To ensure economy in hardware acquisition, USAF has inserted an optimization study for contractors with all major contractors. Space Systems Div. spokesman told the CPIP contract plan has been beneficial and schedule and quality have been maintained. CPIP contracts were awarded almost a year ago since SSD is in effect, is operating under a fixed fee contract from DOD. Air Force feels that the Titan 3 program will continue to receive DOD support until it cost exceeds and scheduled shippers are held within program estimates. Total development cost for Titan 3 is estimated at \$408.5 million. However, the figure probably will grow closer to \$600 million before the end of the research and development phase.

Tight management control is facilitated through use of the PERT-Time cost system and all expenditures greater than \$25,000 must be approved at program director level.

Associate contractors and their related responsibilities are:

- **Dennett Div. of Martin Marietta Corp.**—structure, assembly, test and system integration.
- **Avco-General Corp.**—propulsion system for the three liquid-boosted stages.
- **United Technology Center**—solid rocket motor.
- **AC Spark Plug Div. of General Motors**—inertial guidance.
- **Anaconda Corp.**—inertial supervision.
- **Ralph M. Parsons Co.**—architectural engineering and design of the program transfer-launch complex.

As a rule, contractors will be awarded the making a minimum of four 1% to 2.5% over their cost. For adequate performance, the average reaction time is expected to be about 75% with an expected range of approximately 2 to 12%.

The Titan 3 system, an Air Force project to off air, consists of two ve-

hicles—Titan 3A and Titan 3C—and an interstage transfer vehicle (ITV) complex, designed for a high launch rate with a minimum commission time. Although the only funded and approved launch, publicly announced for the first, 3C will examine the Boeing X-20 (Dyna-Sort), no research and development flights of either vehicle will be flown without payloads.

Payload Variety

The Titan 3 system has been designed to boost a variety of payload configurations, including:

- **Lifting body vehicles** such as Dyna-Sort which develop aerodynamic lift during boost, resulting in unusual stress and load-injection problems.
- **Unmanned landers**, such as the Apollo command and service module (CSM), composed with 120 in. for freight.
- **Standard payloads**, either loaded directly to the freight or enclosed in a 104 in. diameter payload shroud.

Specific uses for Titan 3 boosters which have been studied include the following:

- **Air Force's Midrange Orbital Development Station (MODS)** and NASA's Marshall Guiding Research Laboratory (MORL).
- **Experiments** to support a small space station, including Gemini, Apollo and modified X-20 vehicles (AW July 22, p. 206).
- **Blue Gemini** spacecraft, based on the now-doubtful USAF active role in NASA's Gemini project.

The versatility of the Titan 3 launch system makes it suitable for launching other spacecraft such as those which would be used for manned or unmanned satellite interception and re-synchronization orbit communications. Titan 3C can place 2,140 lb into a synchronous orbit (AW July 22, p. 221).

Neither of the Titan 3 boosters will

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burning time. Propellant is injected into the engine, with nitrogen acting as the pressurizing agent.

The Titan 3 uses a modified Titan 2 ICBM, has been modified to withstand the acceleration forces from the solid boosters and unusual stresses expected in launching living body payloads. A wide margin of structural safety has been designed into the Titan core to provide a significant safety factor for man-rating. Tankage, for instance, has a safety factor of 2 compared with about 1.25 for the modified Titan 2 Gemini launch.

Core Modifications

Structural modifications to the core consist mainly of increasing the thickness of the propellant tank walls. Although extra nitrogen was added to the outer skin and actuators and attachment points were beefed up to handle the heavier loads. The lower wall of the first stage aluminum tank tank, for instance, was increased in thickness from 0.178 to 0.310 in. The first stage tanks are pressurized to ensure airtight capability.

Two solid propellant, 120-in. diameter boosters of the Titan 3C form the vehicle's first stage, but are often referred to as stage zero by program engineers to the same stage number of the Titan 1A and 3C can be activated. Early in the program it was thought that development of the 120-in. solid motor and the accompanying thrust vector control system might be a troublesome problem. Concern over difficulties expected in development of the thrust vector control system, however, has diminished in view of better than expected test results, particularly the recent test of the thrust vector control system during the firing of the huge 120-in. motor July 20 at Coville, Calif. Details of the test and the 120-in. motor were outlined in Aviation Week & Space Technology, Jan. 24, p. 32.

The 120-in. motor development program is on schedule at present and an interim boost is anticipated. Two areas of potential concern, however, have been alleviated: the forward cleave and the longitudinal weld in the steel cases of the motor segments.

The forward cleave, related to the launch segment to rest of thrust at the fore and end of the motor has four thrust to separation ports and one rocket grain port. The thrust termination ports, which would be opened only for emergency abort during the boost phase, are fitted with plates, approximately 3 ft in diameter, explosively attached to inside reverse thrust. Some difficulty in heat treating the forward cleave is anticipated and modifications have been considered, such as reducing the number of ports.

Difficulties also have been experienced in cracking of the longitudinal weld in the 108-in. long motor segment between the solid boosters, the forward cleave and the forward and aft cleaves are being provided by two different contractors to United Technology Center to ensure availability of test and clearance during the flight scheduled test program. Contractors are Curtiss Wright's Aeronautical Div. and Astronautics Div. of Westinghouse Electric Corp.

Each complete four-segment motor system was weighed close to 475,000 lb, but a reduction in the amount of insulation between the propellant and the case later in the test program is expected to bring the figure down to about the target weight of 450,000 lb. Each segment weighs approximately 73,000 lb.

Burning pattern within the solid motor is controlled by cutting the propellant of each segment so that the outer core opening has a larger mass diameter at the top of the segment than at the bottom of the segment. This is accomplished by using a tapered steel mandrel during casting. In addition, the bottom surface of each segment is pitted with a consistent-mass diameter so that the initial burning starts only in the core area and at the top surface of each segment. A small gap is provided between each segment. Thus, burning action proceeds toward the lower outer perimeter of each segment.

Motor Hazards

The transfer of the 120-in. motor are carried out by a dog from the vertebrae so that the thrusting action passes through the center of gravity of the Titan 3C.

During the 120-in. pilot propellant motor research and development program, consisting of 10 development and 10 PRET qualification and flight testing flights, a 95% reliability with a 95% confidence factor is sought.

The two solid motors for each Titan 3C will be added to the core by a main support structure consisting of a bearing, cradle arrangement, with the core resting on the cradle.

Two support arms near the top of each motor keep the motor aligned with the core.

Position of the solid motor from the core is accomplished when test of thrust

is closed. Final stage of the core can be ignited approximately at the time that the explosive belts are fired to jettison the solid boosters. Two banks of four solid propellant motors, one near the top and one near the bottom of the stage, are ignited to thrust the individual stages away from the core.

To launch the Titan 3 vehicle with a minimum countdown and checkout time on the pad, the integrate-transfer-launch (ITL) facility, has been devised. Underlying philosophy is spelled out in the ITL facility title. Vehicle stages and payloads are first assembled and checked out or integrated in controlled environment buildings, remote from the launch pad. They then are transferred by rail, with checkout equipment still attached, to the launch pad for loading, final checkout and launch.

ITL Complex

Design of the ITL complex (AW Feb. 25, p. 37) has been accomplished with a preliminary operations goal for the Titan 3 in mind.

• **Minimum reaction time** of two minutes following conditions, which can be accomplished well in advance of the intended launch. This minimum reaction time is presently primarily for possible activities, intercept and countdown mission. Intercept goal is to be able to intercept a foreign satellite on the first pass around the globe.

• **Capability of launch** in 99% of expected wind conditions at the Cape. Operational availability is thus enhanced by being able to launch during almost all of the expected wind climate at the launch site. This figure is accomplished by a 95% wind condition launch capability for ICBMs.

• **Launch rate** of 60 Titan 3C boosters per year affording three launch pads. Construction of only two launch pads, however, presently is approved and planned. Launch rate of one vehicle every three weeks from the two pads is expected toward the end of the research and development phase.

Reports by Air Force for funding and approval of a third pad at the Air Force Missile Range and another open test site at Vandenberg AFB were turned down early this year by DOD pending establishment of an operational requirement. Air Force would like to use Vandenberg for launch vehicle inspection and surveillance vehicles into polar orbit with a Titan 3C booster. Although necessary vehicle has orbital plane change capability, it cannot design a standard polar orbit polar orbit.

The success of the planning work for the Pacific Missile Range Titan 3 site has been complicated and it is estimated that facilities and equipment for a rapid core pass would cost close to \$10 million extension of the necessary, level sequencing.

Micro-organisms Study

Research in biological micro-organism detection will be conducted by Space-General Corp. under a \$700,000 contract from U.S. Army Research Laboratories, Ft. Detrick Md. Project will involve development of an automated air sampling device capable of rapidly detecting and identifying micro-organisms.



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Germany Links Technical Future to Space

By Wern C. Wetmore

Bad Godesberg.—Germany's entry into the space arena has been prompted by the growing realization that its technological future is closely entwined with high-level scientific and technical achievement in this field.

Consent dating to that Germany cannot attain a leading position in the overall area of space activity and therefore must concentrate on certain specialties, where it is more likely to reap economic benefits, is an attempt to fill possible gaps existing in the broad international spectrum.

Technical aspects for the German space program—which now has environmental goals to 1980—stemmed from the establishment of the united German European Space Research Organization (ESRO) and European Launcher Development Organization. The latter government decided to join them in 1961.

Commitments were signed in 1962, subject to Bundestag ratification. Germany's contribution to ELDO will be the third stage of the ELDO booster, now under joint development in Bad Nauheim and the Northern Development Group (ERNCG). Bad Nauheim is responsible for the guidance package, vector engines and system integration and testing, while ERNCG—in justice to Thales-Wall—will build the structure, test cells and main engine.

Propulsion will be a hypergolic combination of asymmetric dimethyl hydrazine (UDMH) and nitrogen tetroxide. First hot firing is scheduled for 1965.

Previous ELDO program will bear a total price tag of \$146 million, of which Germany will define 22.01%, or \$32.2 million.

Germany's 21.6% proportion of the total eight-year ESRO expenditure of \$110 million amounts to \$26.8 million. ESRO's data-processing laboratory is located at Darmstadt, in Hesse.

Responsibility for the promotion of space research was first assigned to the Ministry of Atomic Energy in January 1962. Then in December of that year, the ministry was redefined to form the Ministry for Scientific Research, having three general tasks:

- Promotion of general sciences
- Nuclear energy research
- Promotion of space science and technology

The Space Research Dept. of the new ministry is headed by Max Mueser and performs a function similar to that of the U. S. National Aeronautics and Space Administration.

A separate governmental space agency is not envisaged.

"Contributions to ELDO and ESRO cannot be effective without a national program in smaller fields," Mueser says. "We don't want to make purely finan-

cial mistakes. In addition to several small hard-rocket clusters now in existence, a cluster 13 ft in diameter—large enough to surround orbit the full-scale third stage of the ELDO booster—can proceed on the drawing boards. This unit is expected to be operational at the end of next year.

• **Project 621—Recoverable sounding** aerial is under development by German Systems Div. Recoverable vehicle will employ liquid propellant and during re-entry, a parachute (AW June 25, p. 75). Maximum altitude ranging as 11 km payload is estimated at 510,000 lb.

• **Project 622—High-energy third stage** for the second-generation ELDO booster is being designed by Bad Nauheim. Propellant combustion area



S-1C Mockup Illustrates Saturn 5 Size

Full mockup of third stage of S-1C stage serving components of NASA's Marshall Space Flight Center-Huntsville, Ala. (AW Aug. 29, p. 31) weighs magnitude of 375 lb. Saturn 5 power rocket. Booster has 13 ft dia. length of 135 ft. It will be powered by five F-1 engines two of which are now mounted beneath third structure in mockup form.

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• **Project 623-Space Transporter** is Backlund's name for its winged, accessible aerospace plane which is intended for logistics support of space stations. The transporter carries its reaction to mass along a slanted, untethered path, but ultimately the cost of such a project would require international cooperation.

• **Project 624-Energy conversion** and electric propulsion will probably entail cooperation between the Space Research and Nuclear Energy departments of the Scientific Research Ministry. Nuclear generation for electric power supply are being considered, either from nuclear model engines (possible conversion includes Stirling, Bussard, Boxer, Co. Interim General Electric Co. (AEC) and Krupp).

• **Project 625-Multi-purpose satellite** weighing approximately 150 lb., has been designed by Backlund and the Cosmo Experimental Aerospace Institute (CEAI). It is intended for both scientific research and commercial use, e.g., as a communications satellite. First generation models will use a solar-heated antenna boiler for power supply, while follow-on will utilize nuclear generation as they become available from Project 624.

Project chairman is that Germany would be neither willing nor able to build a large booster as a part of the national program. The majority of first generation launch vehicles such as those now in use or contemplated by the U.S., Soviet Union, France and Japan would have to be replaced by a smaller ballistic missile program which is non-existent in Germany.

Not a three or four million, space program, "Germany is concentrating its efforts, rather than diversifying them among Army, Navy, Air Force and a civilian agency," says German director of the study.

Available for the national program is still undecided, Major says, due to its economic success and to the fact that the bulk of the projects cost only as much as the study.

Moreover, there is no definite final approval of the new German program as yet.

All applications, including conceptual studies, member and reception studies, are still well in the future, according to Major. When and if the decision is made to go ahead on a national scale program, the Postal and Scientific Research ministries will collaborate very closely. Postal Ministry will deal with ground stations and the necessary equipment for launch down-circuit systems, while the Scientific Research Ministry, through its Space Research Dept., will be responsible for the flight launch.



Lunar Gravity Simulator Tests Mobility

Prototype lunar gravity simulator has been designed by Space-General Corp. to test astronaut mobility in a space and at 1/6th of earth's. Subject shown in a New Model 6 full-motion suit had no difficulty adapting to the machine. The suit, up to 15 ft. 10 in. floor is angled at about 33.1 deg. while subject is held by a harness and cables attached to head, arms, torso and legs. A 14-in. adjustable-speed treadmill is located in center of the "floor." More sophisticated tests is under development.

Meanwhile, Germany will be involved with the European investigation of a possible global coast network. They will teach both ELDO and ESRO and probably will coordinate considerable cooperation with the U.S.

The German government has not concluded any bilateral agreements outside the framework of ELDO/ESRO. Major says, but scientific and technical contacts are being pursued with institutions in other countries, with the intention of establishing closer cooperation.

As things stand now, Germany is the only stable Western nation having no cooperative agreement with NASA for launching of coast sounding rockets or satellites (AW Aug. 12, p. 5-6).

In June, an official delegation from the Scientific Research Ministry, headed by Minister Hans Lenz, made an official visit to the U.S. There, it had a

series of interesting and promising contacts, both with NASA headquarters and research facilities, including Goddard Space Flight Center, Marshall Space Flight Center, Ames Research Center and Los Alamos Research Center, according to Major.

"The hope is that out of this trip a close cooperation in various scientific and technical fields arises," he declares.

One possible area of cooperation is in the Trans-Atlantic program. Germany is considering the establishment of an Automatic Packet Transmission (APT) station on its soil, although this has not yet received official government approval.

In its attempt to get off the ground, the German space program is confronted by a variety of obstacles, primarily financial.

Budget for space activities during 1963, the first year of the program,

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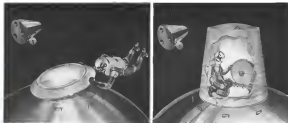
When Jarry Hydraulics Limited, Montreal, was awarded the contract they knew they had a "put-up-or-shut-up" undertaking, because both engineering and time demands were crucial. Using their own 3 plants and a variety of sub-contractors they moved on a round-the-clock

basis, pioneering every step of the way. They didn't have time for design as they produced all components from rough cut steel and aluminum blocks. Tool design and manufacturing were programmed as they ran, so that tools were available at the precise moment required. Lucite duplicates of the manifold block were machined first to prove the tools prior to machining the aluminum. Four rapid-prototyping after conception Jarry officials triumphantly flew the first system to Lockheed's Georgia plant.

Yes, this Canadian team of hydraulic engineers and manufacturers has been coming up with breakthroughs like this for some time now. Next time you have a hydraulic requirement, get Jarry's thinking. A member of the world's most successful aircraft already incorporate it.



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Portable Emergency Spacecraft Airlock Proposed

Portable emergency airlock for spacecraft designed by Lockheed Martin and Spacelab Co. is shown in use in drawing. The collapsible, 35-ft airlock is made of flexible aluminum material lined with gas-tight butyl rubber. One suggested use would be to let crew transfer between spacecraft through an emergency hatch when the regular airlock has been damaged.

accounted to \$5.87 million, of which \$6.14 million was committed for ELDO/ESRO. Only \$1.62 million of this was used, since the consortium had not yet been satisfied by the Bundesflug. The remaining \$2.55 million was allocated to the national effort.

Spacelab appropriation for 1983 was nearly tripled to \$25.5 million. ESRO's share is \$5.65 million and ELDO receives \$5.75 million, while the national program is allotted \$10.65 million, representing a fourfold increase.

Budget Request

The 1984 budget request is in the process of being submitted to the Bundestag. Maser is reluctant to give the exact figure, saying only that it represents "a substantial increase" over 1983. The expanded program probably will be paid incrementally by the legislature, as were the requests for 1982 and 1983.

One industry observer, however, believes the figure to be in the region of \$35 million, at or above \$32 million less than the current French space budget request (AW Aug 12, p. 32).

A memorandum letter to the committee approving the 1984 space budget is the justification, besides, pointing out the federal government will also share German Launcher (Atlas) over the distribution of income tax revenue. At the present time, 55% of the funds go to the Länder and the remainder to Bonn, which is attempting to limit this share, raised to 41.5% in 1984.

Another facet of the problem is that there is believed to be a popular movement (coming from the west) against things associated with rockets, at

though the belief is not universally held. Subscribers to this opinion are generally divided into two schools of thought on the question of how to overcome this difficulty. Some believe that the government should go on and underemphasize the space program, while others advocate a campaign to educate the people and their elected representatives into acceptance of the desirability of a space program.

On the transportation side, Maser feels that German aerospace research is hampered by a shortage of experienced middle-level scientists. As a result of the postwar exodus of experts to other countries in search of work that was not believed that it will be possible to attract technical and scientific personnel back to their native land because of the competition and facilities which they have found in other nations.

New Generation

The hope lies with the new generation of scientists and engineers, he says, and Germany will attempt to equip its aerospace research and development facilities to such an extent that this will be attractive to qualified young German engineers that career.

Federal Aeronautics and German Aerospace Industries (DLFI) estimates that the aerospace disciplines will require 3,700 scientists and engineers by the end of 1986.

In producing this, Maser says technical manpower training is somewhat hampered because Germany does not have specialized technical colleges which concentrate on education in the aerospace field.

To build up Germany's technical and scientific base in this area, NASA and the National Science Foundation will grant graduate fellowships to qualified German students. These students will study in the U.S. and return to Germany afterward.

However, this is only a stopgap measure until sufficient activity in the aerospace disciplines is generated in the German institutions.

Aiding Groups

Spacelab Research Dept. of the ministry is actively aided in planning and reviewing its work in a variety of bodies, most of which were created especially for the space program. Included are:

- **Spacelab Research Co. (GWFA)**, a non-profit organization headquartered in Bonn, is the executive arm of the Spacelab Research Dept. The company grants and supervises contracts to industry and research institutes according to the Spacelab Research Dept. a program and participates in the sponsorship of aerospace research establishments. For the present, no in-house research and development activity is planned in GWFA.

- **German Flight Sciences Society (DFG)**, an old-line organization, is generally concerned with space flight technology, rather than with fundamental research. Projects are planned in low speed aerodynamics, flight performance and control channel properties and advanced propulsion systems power supply, computerized, storage of scientific data transmission, applied aerodynamics (aerodynamics), space medicine, recruitment and training of personnel and dissemination and information.

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5-IC Booster Component Jig Shown

Large chassis fixture with steel struts is to be utilized by Boeing-Wheeler in building two sets of thrust rings for the 5-IC first-stage booster of the Saturn V vehicle (AVC May 25 p. 58). Raising the power content on the 5-IC. Large jig is adaptable for the two different sizes of thrust rings that the company will build.

grain concentrates generally on motor plunger operation, including such problems as extraneous material, design, fundamental atmosphere and plunger plunger research and space electronics.

The group provides support for an earth research project.

• **Max Planck Institute of aerospace** (Mars) and nuclear physics (Mars) high core and space research on their aerospace disciplines.

• **German Space Research Committee**, a clearing house consisting of leading figures from science, engineering and industry, was established on Sept. 6, 1962. It works in questioning grants on research and development projects and places the research on priorities and planning of space research.

• **Space Flight Technology Committee** was founded jointly by the DGLR and DGL in June 1961. This committee, along with a European space research and development program for the DGL and for industry, which it submitted to the research. Problems to be investigated by the research establishments associated with the DGL are outlined in the plan below.

• **Koerber-High speed flight** at very high altitudes with various digital temperature distribution and environment, cooling and boundary layer problems.

• **Tight mechanics and control**—high speed studies and control in vacuum and near-vacuum conditions: trajectory competition and trajectory control, radar controlled transverse navigation, with particular emphasis on celestial

navigation, high-velocity control and regulating mechanisms: armoring techniques and simulation.

• **Propulsion and power equipment**—Infrared thermal propulsion efficiency, chemical, solar and nuclear power sources and direct power conversion.

• **Structural design, strength and materials**—The real stress on spacecraft due to solar and cosmic heating, reaction heat protection, dynamic behavior of thin-walled structures of ionospheric and dynamic stress, materials in fatigue in vacuum, some present and future of materials under interplanetary conditions.

• **Signaling and intercommunication equipment**—Built-in antennas for guidance, position finding and trajectory determination, navigation by means of celestial, signal navigation, position, signal navigation and applications of optical and solar trajectory measurements.

• **Space medicine**—Integration of human in functional elements in space, technical problems under the physiological and psychological aspects of space flight determination of ability to withstand such stress by simulation of actual conditions.

• **Measurement**—Involves all types of atmospheric or spaceflight structural, geophysical and distribution, surface, conditions and various systems demand process and trajectory variations of high altitudes, direct and reflected solar

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education on various special stages and soft influences on weather.

• **Applied mathematics**—Increased utilization, as required in space technology, of certain branches of mathematics, such as statistics, operational research, probability theory, group theory and Li-Poisson techniques.

• **Physics and chemistry**—Effects of space environment, hard vacuum, low temperatures, radiation, weightlessness. Industrial projects suggested by the committee are included under the national and ELDU programs. General industry has given active support to the committee, and has submitted a great number of unsolicited proposals, Mavor says.

The committee also laid down broad financial guidelines for the four years. Total cost is estimated at \$235 million, with \$47 million devoted to research and \$189 million going to industry. However, these figures probably never will be realized completely. The first year of the program, 1965, called for \$11.4 million, whereas only \$25.1 million was appropriated.

Summarizing the tasks that he should, Mavor:

"The committee does not intend to use the taxpayers' money to carry out a thorough examination of the back of the moon. What interests us is our openness to activate General science and technology through effective cooperation in space research in such a way that no one can later say that General has been helped in other countries in the relevant fields."

Oxidizer Leaks Found In Titan 2 Missiles

Washington—Slow leaks of nitrogen tetroxide oxidizer through second-stage joints are causing common problems in some USAF Martin Titan 2 KBMs at operational sites.

At Fitty last week said some of the missiles can be repaired on site by the installation of improved joints, but others will be returned to the Martin Denver plant for overhauling.

When nitrogen tetroxide is exposed to water or water vapor, nitrous oxide and nitric acid are formed. The weak acid weakens the linkage which is made of 2048T aluminum. Titan 2 propellants are nitrogen tetroxide and an equal mixture of ammonium dinitrate hydrazine and hydrazine. Leakage is so small that it took one week for a cube resistor of fuel to accumulate and be detected.

Titan 2 operational sites are at McConnell AFB, Wichita, Kan.; Davis-McCormick AFB, Tucson, Ariz.; and Little Rock AFB, Ark. The squadron at Davis-McCormick has been alerted for occasional and others soon will be.

PROBLEMATICAL RECREATIONS 187



The results were: winner had a 25, 23, 34 figure. Although no two contestants had exactly the same measurements, the two runners-up differed less than an inch in such measurements from the winner and the winner of each was 45 the legs of the other. If the sum of the three measurements was the same for all three girls, what were the real statistics of the two runners-up (the tape is accurate only to the quarter-inch). —Continued

Figure we might see next this week, so here are the latter: WAAAF AFA Annual Convention and Aerospace Pasadena, WAFW Wednesday through Sunday, WAFWRE Sheraton-Park Hotel, Washington D.C. Later divisions will be an display in the Continental Room. Look for exhibits from RADCOM, Guidance and Control Systems and Data Systems. We hope you may make it, answer to LAST WEEK'S PROBLEM. The probability is one, since any three points on the surface of a sphere are always located on some hemisphere.

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kearfoott technical information report

ANALOG COMPUTERS, CONVERTERS AND DISPLAYS



Having produced more than 17,000 analog navigation computers, we've come to the conclusion that analog computers have considerable merit. In fact, we're planning to build quite a few more.

We're not saying that digital machines are poor. There's as much need for computation as pure digital form as there is for analog. However, analog computers do have certain major advantages...lower cost, real time computation and elimination of elaborate converters.

When examining the requirements for navigational computers you needn't be concerned with complex programming and storage, since these considerations are inherent to analog computers.

For a further exposition on analogs, we'd be delighted to give you the booklet pictured above. Please send for it.



MINAC-3 NAV COMPUTER We'll spell the name again—MINAC.

Three models stand for Miniature Autonave Navigation Computer—the best available.

For the Doppler people, there is the MINAC 5. For those who prefer inertial, we have MINAC 8.

The computer is small—occupying only 16 cubic feet. Weight is 30 pounds, including the control indicator.

It's versatile, providing present position, wind speed and direction, distance to destination, bearing and ground track relative to true heading, true heading, ground track and ground speed. It can store two flight distributions and accept altitude distributions without loss of primary data. Naturally it's accurate—in 0.25% of total path traveled or 1 NM/HR, whichever is greater.



A well engineered control indicator goes with this flight-tested computer.



AN-VN-2 COMPUTER The AN-VN-2 Computer, with moving base capabilities further demonstrates Kearfoott's versatility. This computer is designed for Autonave AS-4 as feed or memory-aided aircraft. The unit consists of computer and control indicators, receiving data from any Doppler Radar set, Map-Metric Computer and Air Speed Transducer. It computes N-S and E-W components of airspeed ground track and wind velocity, and of distance traveled.

The AN-VN-2 can also incorporate a supplementary function. It receives inputs of a moving base velocity and heading, then computes and displays the bearing plan R-S, E-W data needed for the aircraft's return to its operational base.

Further capabilities include continuous display of present position heading relative to take-off point, and distance, and bearing to any selected one of four stored destinations.



COMPUTER INDICATOR Ground speed and drift angle are computed and displayed with Kearfoott's T8605-22N—specifically designed for rotary wing aircraft input signals to the AS-4, relayable lighted computer indicator unit from Doppler radar, representing heading and lateral axis speed. We then solve for hypotenuse and cosine functions of the input voltages by a defined resistor array and a ground speed to low up servo. Accuracy and sensitivity are assured from 2 to 180 knots. Display order range is depicted above 10 cps. The T8605-22N is complete with two transistorized servo amplifiers, two transistorized buffer amplifiers and their individual power supplies, packaged in little more than 1/20 of a cubic ft. Environmental performance of our compact computer package meets all applicable requirements for MIL-E-5400, MIL-E-5272, MIL-E-5422 and MIL-15511.



A-D CONVERTERS Proving we're not only a digital-and-analog we know there's a good market for better products—we've developed the finest 36-bit Digital converters available—all in the standard 31/16 diameter. These modules are complete with internal logic, and provide BCD (8-4-2-1) short position output with overall accuracy of 0.4 bit.

They're available in ranges from 0-999, 0-9999, 0-99999, 0-999999, 0-9999999, and 0-99999999.

The converters can be reset on the fly, or on demand, at speeds up to 500 RPM, and sampling rates of 50,000 counts per minute without ambiguity. With proper maintenance, expectatively long life is assured—50,000 cycles at 500 RPM with no wear of 3610° cycles per minute.

Other characteristics include low torque—0.3 oz. in., low inertia—25 gm-cm² power <0.05W, 2 Ma per bit.

Each module contains "DIP" pins, and is designed for serial interruption to allow time showing of selection logic and procedures.

Gold alloy tracks and brushes make for low noise and minimum wear.



DELIN Another display problem is solved with Delin, Kearfoott's solid state indicator, accepting BCD input—displaying alpha-numeric values in a seven-segment electroluminescent panel.

The standard 3" indicator above contains a binary to decimal converter driver, lamp encoding matrix, solid state switching matrix, lamp and associated electronics.



Delin is also produced in stick form, incorporating all necessary logic and switching circuitry and lamp, for individual alpha-numeric digits in a self-contained unit. Delin sticks can be stacked side by side, developing a display of any word length. A special 3-digit stick form display is about the size of a cigarette pack, and provides 7 ft. lumens light output. It operates over a temperature range of -55° C to +71° C, and meets all applicable requirements for MIL-E-5400.

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FIRST PRODUCTION BELFAST turboprop transport is nearing completion at the Short Brothers & Harland facility in Northern Ireland. Two more aircraft are shown at advanced construction stages in the background. Belfast will be rolled out late this month.

Argument Continues Over Belfast Future

By Herbert J. Coleman

Belfast—One of the most bitter debates played out in the history of British aviation—the Short Brothers & Harland turboprop Belfast transport—will enter its fourth year as a contentious issue.

After four years of development, the big Belfast is still the subject of intense argument between the Ministers of Aviation, in charge of development contracts, the Air Ministry, which will use the airplane, and a strong and vocal faction in the Houses of Parliament.

So far, the government, which owns 75% of Short Brothers, has made its position on the Belfast quite clear—the order of 10 airplanes stands and will not be increased.

But the members of Parliament, particularly the powerful 14-member group representing Northern Ireland, are pushing for an increase in the order to 20 and there has been some quiet, behind-the-scenes, support for this in top echelons of the Royal Air Force. Another group in British Overseas Airways Corp. supports an order for five freighters for the transatlantic and Commonwealth routes.

Downside factor in the steel and iron, or exacerbating the technical uncertainties in Northern Ireland, is a chronic unemployment problem. Almost 5% of the adult male population is unemployed and if Short starts out of business, another 7,000 will be laid off.

Right now, Short executives are fighting against the inevitable dismantling of its design team. G. E. Wright, the chairman, and the firm's strength has fallen by 75% in the last 17 months. Over the last five years, employment at Short has dropped by £2.55, compared with 5.1% for the aircraft industry as a whole.

Wright says that if the company's current design team dissolves as further, the entire Belfast program will be endangered. He is pressing for an immediate decision on various projects submitted to Ministers of Aviation in London.

Presently, that is, besides the request to increase the Belfast order, a government support for the Turbo-Slovak two turboprop transport program, now limited to a single prototype. Short wants a guaranteed production run of at least 10 and is confident, so the

base of world operator interest, particularly in America and Alaska, that the airplane can have a wide sale.

Meanwhile, the company is actively selling its production capabilities through a number of international agreements that, in fact, have resulted in no hardware commitments. These include:

- **Sales and license production** of the Regent 941 STOL transport. Short has submitted a VTOL design to the ministry, involving eleven jobs of Rolls-Royce RB171 gas turbine engines.
- **Deal with Chance Vought** to build the Crusader jet fighter in Belfast if the airplane is ordered in quantity by the Royal Navy (AVW Aug. 5, p. 39).

- **Construction of Wales** helicopter in Northern Ireland, another agreement based on potential military and civil orders in Great Britain and Europe.

- **Attempt to match the Air Transport Auxiliary requirement** for a DC-7 replacement with a two-jet light transport now taking shape in the drawing boards at the preliminary design team, headed by Frank Robertson.

Robertson also is working on a STOL version of the Slovak, possibly competing on the military market. Government intention to field any

port the Slovak has severely hampered the program since the day Short bought design rights from Frank Debus and F. G. Miles, Ltd. First prototype was built with Continental GTS 2000 piston engines. Flight program, totaling 47 hr, was marred by heating problems contributing to a number of engine failures and a redesign of the pods.

Instead of building a second prototype, Short selected the flight program after initial drop tests and now is rebuilding the wing to take the Turbo-slovak Astorion 10 engine, producing 645 hp and driving an 8 ft 7.4 in. Kvaerner propeller.

For initial flight testing, the airplane will be fitted with two Turbomeca Astorion 2 engines of 550 hp. However, development of the Astorion 10 is so advanced that Short will enter it for the production version and has accordingly increased the gross weight to 12,500 lb. for a maximum payload of 4,000 lb. The Astorion 10 has an additional vital stage in the compression section to produce the extra power.

STERMA also is developing the powerplant in a package project, along with Kvaerner, to reduce aircraft maintenance problems for the operator under field conditions. Engines will be serviced with low tools and five electrical connections. Astorion 2 hose services overhead now 1,000 ft.

Only modifications necessary to transform the airplane into the Turbo-Slovak are a wing leading in the center section, and making the tail surface fairer for better engine performance. Nose wheel steering will be added and Short is sending out potential operators about necessary for additional fuel capacity, increasing the size of the tank, in the



ROLLS-ROYCE TYPE 52 turboprop engine is mounted on the first Belfast freighter. Engine develops 5,750 hp and drives a 16-ft propeller, 35 ft prop is being considered.

top fuselage. There is a possibility that integral tanks will be fitted in the wing, depending on customer requirements. Airplane was designed for single pilot operation, but Short plans to effect more 550 hp engine with dual controls, again an optional item.

Motors version of the Turbo-Slovak will be powered by two Astorion 12 engines, rated at 660 hp each, with remote direct section midline. Maximum power is selected by push button on the control console, bringing the engine to a constant rpm of 43,000 and power controlled by regulating the pitch. Military version will carry 15 fully-equipped troops in rear living units.

On the Belfast production line, the No. 1 airplane is rapidly approaching completion and four Rolls-Royce Type turboprop engines have been mounted. Four more Belests are in advanced stages and the rest of the 10-plane order is in the pipe.

Fuselage of the Belfast is built in eight major components, considering that the tail section is constructed in two sections and then joined. The rest are two fuselage sections, the center section, two tail sections and the tail section. Wings are built in Bristol Aircraft at Filton, England, and shipped to Belfast for final assembly.

For assembly purposes, the fuselage



SKYVAN, an test flight proved to two Continental piston engines, is being modified in an Astorion-powered Turbo-Slovak version.



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Both have an eye on the budget

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Short Turbo-Skyvan

(Performance based on two Turbosmart Antenna 18 propellers)

Weights	
Aircraft prepared for service	7,800 lb
Maximum payload	4,800 lb
Maximum fuel	1,400 lb
Gross weight	12,500 lb
Dimensions	
Span	64 ft 1 in
Length	36 ft 9.5 in
Height	19 ft
Fuselage hold	36 ft x 64 ft x 64 ft
Takeoff	
Ground roll	1,300 ft
Distance to 50 ft	1,900 ft
Climb	
Sea level rate of climb (2 engines)	1,600 ft/min
Single-engine rate of climb	400 ft/min
Typed Cruise (18,000 ft)	
Max. continuous	254 mph
Max. economical	175 mph
Max. range-min. payload	495 stat. mi.
Max. range-min. fuel	675 stat. mi.
Landing	
Distance from 50 ft	1,300 ft
Ground roll	1,400 ft
Distance from 50 ft (reverse thrust)	1,170 ft
Ground roll (reverse thrust)	700 ft

airframe, nose section and tail are brought to the front section for jacking into a complete fuselage. Section are installed in wings before mating with the airframe, and entire unit is moved forward for installation at the Type engine and exhaust equipment.

Jet Belfast

Short Brothers is still proposing its jet Belfast transport in the world market, using a wing based on a Lockheed design for the C-141 jet transport (AW June 10, p. 33). After losing the RAF competition for a V/STOL fighter to the Whitworth Gladius-61A, the company has been persuaded subcontract work on that airplane and on the RAF's five Vulcan VC-10 all-weather jet transports.

However, no contracts have been signed and, in the case of the VC-61A, the work is for six years in the future at any rate.

In the VTOL field, Short is limited to Ministry of Aviation funds awarded to its two SC-1s, one flying at Royal Aircraft Establishment (Belfast) as an exploration of VTOL, cockpit instrumentation for blind landing, and the other as a series of tests on auto-rotation devices. Latter is now testing on

electronic control system in free flight after a number of gusty tests had proven the feasibility.

Prime money source for the company is the Royal shipboard anti-aircraft missile which has been sold to six foreign nations including Chile. Exported version for land launch has not with little success since British Army has shown little interest in adding the weapon to its inventory, sale to the Army is considered a vital step in restoring foreign governments.

Cost Reduction

Design team presently is involved in a cost-cutting program, mainly in the area of equipment manufactured by other firms. One aim is wider use of instrumentation and substitute devices in the aircraft's guidance system. Another is completion of a new simulator for crew training of Belfast work the unit and construction part of a sales push, agreed.

Last known aspect of Short Brothers work is in construction of home vacuum cleaners, a department which barely broke even last year. New vacuum cleaners will be a completely different brand name and making design which will be offered for sale shortly.



1933 target: vehicles on a highway



1963 target: vehicles in space

Thirty years ago, Westinghouse engineers in East Pittsburgh learned space never from the giant steel and deflated rubbery target a block away. They didn't call it "target"—the word hadn't been invented yet.

Under development at Westinghouse has provided many paths since 1933. Defense Center scientists have consistently pioneered in advancing the art—from the rooftop experiments to detecting enemy

planes approaching Pearl Harbor to tracking vehicles in space.

Systems in action today include tracking for airborne and space missions, search and weapon control, tactical and fixed air defense, shipborne and ground-based acquisition and tracking. Typical of current projects at the Westinghouse Defense Center are the AEGIS air shipborne fire control radar for the Navy's TRIPWIRE program and the land-based

AN/SPS-20, a long-range air defense radar in the Air Force's AEGIS system.

Continuing Westinghouse leadership in radar research and development anticipates a unique capability for the future. It is a capability to be reckoned with in any serious discussion of advanced radar systems. Write to Westinghouse Electric Corporation, P.O. Box 608, Pittsburgh 26, Pennsylvania. You can be sure — it's a Westinghouse.

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FINANCIAL BRIEFING

Fairchild Strike Corp. had losses of \$572,000 on sales of \$70.6 million for the first six months of 1965. Same period last year showed earnings of \$1.5 million on sales of \$35.8 million. Fairchild's losses were reduced by a second-quarter profit of \$714,000 on sales of \$15.5 million.

Moog Science Corp., Inc. had a net income of \$354,117, equal to \$1.17 per share, on sales of \$19.2 million for the first half of the year. Comparable period last year showed net earnings of \$469,726, equal to 94 cents per share, on sales of \$14.2 million.

Borgess Corp. earned \$5.4 million, equal to \$1 cents a share, on sales of \$18.2 million for the first six months of 1965. Comparable period last year showed earnings of \$4.5 million, or 67 cents a share, on sales of \$107 million.

Magnetek Corp. reports sales of \$23.2 million with earnings of \$111,267, equal to eight cents per share, for the first 28 weeks of 1965. First 28 weeks of 1964 showed sales of \$20.7 million with earnings of \$97,097, equal to 66 cents a share. The company's 1965 sales figure did not include Borgess' in-flight target work—worth \$10 million last year. Magnetek management attributed this year's drop in earnings to high start-up costs on new projects associated with its development program (AW Aug 18, 1965, p. 115).

International Telephone and Telegraph Corp. reports earnings for the first six months of 1965 of \$21.5 million—\$3.25 a share—on sales of \$593.4 million. Comparable period last year showed earnings of \$14 million—\$1.11 a share—on sales of \$488 million. Order backlog stood at \$812 million on June 30.

Grumman Aircraft Engineering Corp. reports first six months earnings for 1965 of \$3.7 million, equal to \$1.67 a share, on sales of \$23.4 million. First half of 1964 earnings totaled \$1.2 million, or \$1.05 a share, on sales of \$106.9 million. Order backlog on June 30 was \$526 million, including the seven-year Lunar Fusion Module (LFM) project.

Thiokol Chemical Corp. earned \$5.1 million, equal to 62 cents per share, on sales of \$14.6 million for the first six months of 1965. Earnings for the same period last year totaled \$3.1 million after adjustment for a 40% stock dividend. Previous earnings were 63

cents, and sales were reported at \$128.6 million.

Collins Corp. reports unaudited earnings of \$70,000, equal to 65 cents per share on sales of \$13.8 million for the fiscal year ended May 31. Earnings for the previous year were \$1 million—90 cents a share—on sales of \$38.2 million.

Loar Segler, Inc. reports sales of \$29.5 million with earnings of \$4.4 million, equal to \$1.30 per share, after preferred dividend requirements for the year ended June 30. Sales for the previous year totaled \$190.6 million with earnings of \$6 million, equal to \$1.51 per share.

General Controls Corp.'s unaudited figures for the first six months of 1965 show earnings of \$408,795 on sales of \$13 million. Same period last year showed earnings of \$439,000 on sales of \$21.7 million.

Thompson Ramo Wooldridge, Inc. reports net sales of \$740.8 million with earnings of \$7 million, equal to \$1.84 per share, for the first six months of 1965. Same period last year showed net sales which totaled \$232 million with earnings of \$6.4 million, equal to \$2.68 a share.

Packard Bell Electronics earned \$835,000, equal to 91 cents per share, on sales of \$18 million for the nine-month period ended June 30. Comparable period last year showed earnings of \$715,000—89 cents per share—on sales of \$36 million.

Miles, Inc. reports sales of \$35 million and net earnings of \$732,447, equal to 29 cents a share, for the first six months of 1965. Comparable period last year showed sales of \$37.2 million and net earnings of \$444,732, equal to 18 cents a share.

Chikens Aircraft Industries, Inc. had a net profit of \$227,000, equal to 46 cents a share, on sales of \$4.7 million for the first half of 1965. Comparable figures for last year showed a loss of \$285,504 on sales of \$4.2 million. June 30 order backlog stood at \$11.8 million.

Pratt-McGrath-Bowen Bearings, Inc. earned \$5 million, equal to \$1.63 a share, on sales of \$85.7 million for the first six months of 1965. Figures for a comparable period last year showed earnings of \$7.6 million, equal to \$1.50 a share after adjustment for a 40% stock dividend. Previous earnings were 63

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Bell, Hiller LOH Modifications Shown

Bell Helicopter's OH-6A entry in Army's light observation helicopter (LOH) competition is shown (above and below) in its latest configuration during recent flight testing. Federal Aviation Agency certification tests currently are being conducted. Modifications made on the original airframe include a 50-in. extension of the nose to reduce drag, addition of a revised fin on the tail boom to improve directional stability and addition of an external brace on the underside of the fuselage at the tail boom attachment point. The horizontal stabilizer (top photo at right) of tail boom was moved forward 30 in. to improve longitudinal stability. Cowled air vents on the sides of the forward rotor mast covering lens have been replaced with the photographs were taken with vents in the front. This improves the airflow for instrument cooling. Engine exhaust deflection (bottom photo at rear of exhaust ports) also have been added. The OH-6A is powered by a 250-shp. Allison T62A-5 turboshaft engine.



Hiller Aircraft Co.'s OH-5A, prototype developed for Army's LOH (light observation helicopter) competition is shown above during recent high-speed tests. The OH-5A, Bell's OH-6A and Hughes Aircraft's OH-6A will be evaluated by Army only after one is a preliminary step in a program which is expected to result in orders for about 400 light observation helicopters. No changes have been made in the prototypes since the flight test program began, but they do have some external differences from the aircraft used to make the first flight (AW Feb. 4, p. 35). Up-tilted exhaust deflector on the rear of the engine exhaust ports have been eliminated (above) and fairings have been added to cover the tail rotor power shaft, which runs along the top of the tail boom, and to cover the tail rotor transmission assembly. Rear view (right) shows closing of the tail rotor struts and the engine engine compartment, which permits narrower windows. Bottom photo shows a simulated flight of two OH-5As, which currently are being used in Federal Aviation Agency flight certification tests. Hiller design is fitted with an automatically stabilized rotor system similar to that being produced for the company's T-3 jet-engine helicopter. The OH-5A also is powered by the Allison T62 turboshaft engine.



Velocity Sensors Apply Mossbauer Effect

By Philip J. Kline

Middle River, Md.—Unusual type of velocity sensor expected to exhibit remarkable accuracy and sensitivity in measuring relative speed between two objects, is under intensive investigation here for a variety of aerospace applications by the Martin Co.'s Eastern Starline and Products Div.

The technique, based on the Mossbauer Effect, discussed in 1958, which until recently had seemed to be an unusual phenomenon of interest primarily to basic researchers. It utilizes gamma radiation from a relatively low energy isotope which can pass through solid objects, suggesting interesting new applications.

Martin currently is using cobalt 57 and iron 57, materials which exhibit the Mossbauer Effect. Iron 57 is a stable isotope formed when radioactive cobalt 57 decays. Martin believes this material can effectively permit accurate measurement of relative velocity of two objects to a resolution of 0.01 cm/sec (0.0003 mph). In theory, at least, measurement of velocities to even greater resolution should be possible, using related techniques and/or other materials.

Possible Applications

Martin already has proposed 18 different possible applications for the new technique, which it calls, in the interim, applications of GAMMA TRACK (Gamma Absorption and Reflection Detection Tracking). Most of these applications, however, either are classified because of ongoing government contracts or the company is reluctant to discuss them because of its desire to get the jump on competition.

One possible application which Martin mentions is the use of the technique for radar-invisible guidance. In two experiments, which was suggested by the extreme accuracy and sensitivity of the technique, which Martin neither confirms nor denies, include control of the rate of descent of a Lunar Lander Module (LLM) and measurement of the orbital acceleration of a rocket booster at liftoff to check the operation of its propellant.

Martin scientists were scheduled to discuss their work at the Third International Mossbauer Effect Conference held late last week at Case Western Reserve under Advanced Research Project Agency sponsorship. Dr. Rudolph L. Mossbauer, who received the Nobel Prize in 1960 for his discovery and use

of a principle at the California Institute of Technology, was scheduled to deliver the introductory paper at the conference.

Mossbauer's discovery provided a relatively simple method by which to measure the Doppler shift of gamma rays emitted by a radioactive material when such material is in motion. Viewed from the standpoint of conventional electromagnetic theory rather than quantum mechanics, the new technique gives an accurate measurement of the fact that the amount of Doppler shift increases with the frequency of the carrier. For gamma rays, at the upper end of the spectrum, this is approximately 100,000 times more sensitive or roughly a billion times the carrier frequency used in conventional Doppler radars.

If a small cobalt 57 radioactive source is mounted on one of two objects whose relative velocity is to be measured and the first line of iron is separated on the other to act as an absorber, the iron 57 will become radioactive in absorbing gamma rays emitted by the cobalt 57 as

long as there is no relative motion between source and absorber. This condition, known as "nuclear resonance," will not occur, however, when there is relative motion between the two. When nuclear resonance occurs, the absorber itself will emit gamma rays in its atoms return to their original non-radioactive state.

Detection Methods

The existence or absence of nuclear resonance, indicating the absence or presence of relative motion between source and absorber, can be detected in two ways. If a scintillation counter (which counts gamma ray photons) is placed in line with the cobalt 57 source and behind the iron 57 absorber, the detector will be exposed to gamma rays emitted by the source which are not absorbed by the iron 57 (see sketches, p. 51).

Thus, under non-resonance conditions there will be a maximum number of such photons impinging on the scintillation counter, while resonance causes the number striking this scintillation counter to



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EXTREMELY ACCURATE and sensitive velocity measurement system, which utilizes the recently-discovered Mossbauer Effect, is under investigation by Martin Co. for variety of aerospace applications, including spacecraft navigation. Experimental setup of Martin shows radioactive source (1) tried to lead (2) and the scintillation counter (3) used to detect presence of nuclear resonance in iron 57.



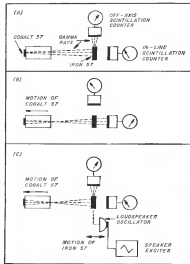
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MOSSBAUER EFFECT, as applied to Hunter velocity sensing system, is shown above. When both cobalt 57 source and iron 57 absorber are stationary, gamma rays emitted by source are absorbed by iron 57, resulting in nuclear resonance and gamma ray reduction in the iron 57 which is detected by off-axis scintillation counter (A). If, however, the cobalt 57 source is in motion, resonance does not occur and its gamma rays pass through absorber to be detected by on-axis counter (B). To determine velocity of cobalt 57 source, the iron 57 can be attached to loudspeaker cone, excited by triangle shaped wave whose frequency is varied with nuclear resonance sensor. Second coil on speaker ring (not shown) indicates cone velocity, hence cobalt 57 velocity, at resonance condition.

be greatly reduced because of sharp loss in the iron 57.

Because the iron 57 emits gamma rays during nuclear resonance, it is also possible to detect the condition by placing a second scintillation counter off-axis when it is not coupled to gamma rays from the cobalt 57. When two sensors across the gamma ray scattering off-axis counter are in sharp, being referred to occur since when the iron 57 nucleus between source and target deviates the resonance condition.

By using the pattern of both scintillation counters in the form of a ratio, it is possible to obtain a relatively sharp minimum, or maximum, when resonance occurs, depending upon which is read in the numerator of the ratio. This provides a value which detects motion between source and target but added precision is added to make it measure the magnitude of this velocity. One way to do this is to mount the iron 57 on one of a loudspeaker. When an alternating signal with a burst for

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inght) wave-lengths is applied to the driving coil of the speaker, the cone and attached iron 57 absorber will oscillate in the direction of the robust 57 source and the sheet to which it is attached. By varying the frequency and amplitude of this applied signal it is possible to find one point in the extension at which the iron 57 is moving at precisely the same speed, and in the same direction, as the robust 57 source, as indicated by a resonance condition in the iron 57.

By equipping the loudspeaker with a second coil, which serves as a vector of same velocity, the voltage induced in this coil will be perpendicular to the velocity of the iron 57 absorber and insurance to the relative velocity of the robust 57 source and the sheet to which it is attached.

Moving Object

Naturally, the concept works equally well if the iron 57 absorber is attached to the moving object and the robust 57 source remains fixed, or if both are moving.

Martin currently is using a loud speaker oscillator for some of its experimental work. However, company engineers are developing more sophisticated and accurate techniques for performing the equivalent function which use return tubes that oscillate in phase.

For some time prior to Mosbauer's discovery, the theory of nuclear interference had been known. In some way it has been recognizable to the point that takes place in setting the stage for their action. In the past, when light, external energy supplied by a flash lamp, is absorbed by a substance, energy is absorbed by a higher energy state. These excited atoms then drop to their original level, emitting photons of light in the process.

Similarly, the atoms of non-radioactive iron 57 can be elevated to a higher energy, intermediate level by action of energy supplied from an external source. They then quickly revert to their original ground state, giving off gamma-ray photons in the process. For iron 57, half the atoms drop to the ground level in 0.1 nanosecond, an interval referred to as the half-life.

But when the rate at which an accept energy over a relatively broad band of wavelengths for later action, to achieve nuclear resonance the match between the external source and the target material must be exceedingly close.

The logical source for supplying the "jumping" energy to raise iron 57 from its stable to a radioactive state would be the robust 57 radioactive source near the wavelengths of gamma rays emitted by the robust 57 in changing to its intermediate iron 57 and then to a non-radioactive iron 57 might appear to be precisely that needed to move the latter back to its radioactive state.

However, when most radioactive iso-



RADIOACTIVE COBALT 57 source, with strength of 2 microcuries, is deposited between 2 thin sheets of copper (left), while iron 57 absorber is thus film deposited on copper sheet, as shown in photo (right). The cobalt 57 poses no hazard unless exposed to blood through broken skin areas, according to Martin's Mosbauer study group leader, Roy M. Martin. However, large group are usually exposed more intense radioactive source.

topes emit a gamma ray photon, there is a great deal of energy involved in the action which causes the photon to emerge with slightly lower energy than it otherwise would have. Expressed in another way, a very slight Doppler shift occurs in the frequency of these gamma rays at emission.

When this photon impacts on a non-radioactive isotope derived from the source material, recoil action also occurs as an action which results in an additional Doppler shift. Result in this effect is the molecule. Doppler shift is a positive shift in the frequency which can be tolerated and so nuclear resonance can occur in the target material.

British scientists in 1957 at the University of Birmingham discovered the idea of using external systems to compensate for this Doppler shift to achieve nuclear resonance. With a stable isotope of mercury attached to a stationary lattice and a radioactive mercury isotope source mounted in the area of a crystal, the British scientists achieved resonance when the compound of velocity, produced by the centrifuge on the direction of the absorber coincided with the Doppler shift caused by external source.

It was not until five years later, however that Dr. Mosbauer, while studying the characteristic radiation of crystal lattices, came to gamma wavelengths, discovered how to eliminate the Doppler shift due to recoil. He found it was possible to anchor some of the source nuclei in a nonrigid crystal and that the nuclei of the crystal could be reversed by crystal cooling. Using iron 57, 101 nuclei to liquid as a transition, Mosbauer achieved nuclear resonance without external motion between source and target nuclei in that needed previously.

Since that time at least 15 other Mosbauer Effect materials which exhibit low recoil have been reported. The cobalt 57/iron 57 that Martin uses are particularly easy to use because their low recoil sufficiently over-recoil losses at room temperature.

The amount of highly required depends upon the recoil energy of the gamma ray photons emitted. The crystal lattice must be higher than the recoil energy to prevent the transition from being loose. Where Mosbauer's original studies 101 nuclei photons with an energy of 125,000 electron volts (e.v.), the photon involved in the transition of iron 57 has an energy of only 14,320 e.v., requiring far less crystal binding force, Martin's Roy Matthews points out. Matthews is leader of the company's Mosbauer study group.

An important parameter of Mosbauer materials is their "resonant line width" which indicates the maximum allowable deviation of the gamma ray frequency, or photon energy level, which will still produce nuclear resonance in the target material. For iron 57, the resonant line width is about 4.5×10^{-6} e.v. That is to say, if the energy of the incoming photon deviates by more than this amount from the 14,320 e.v. needed by iron 57, roughly one part in three thousand (1 in 3,000), resonance will not occur.

Intrinsic Sensitivity

The ratio of gamma ray energy to resonant line width, referred to as Q, is an important figure of merit in evaluating the intrinsic sensitivity of a Mosbauer material to external motion between source and absorber. In fact, for iron 57, which has a Q value of 2.5×10^8 , it is necessary to isolate the source and target from external vibration for satisfactory operation or to devise compensatory techniques.

However, there are other Mosbauer materials such as Thulium 169, with lower Q values (7.4×10^7) which are far less sensitive to external vibration yet still should provide extremely accurate velocity measurement capabilities. Therefore, Thulium 169 requires cryogenic cooling.

Other factors which affect the choice of materials include the following:

- **Half-life** of the source—the time required for strength of its gamma rays to drop 50%, must be adequate for the particular application. Cobalt 57 has a half-life of 170 days, the longest of the known Mosbauer materials. Other Mosbauer materials have shorter half-lives ranging from 24 hours to 15 minutes.
- **Photon energy** which is a factor in determining basic sensitivity to small transients at velocity as previously described, also is a factor in determining the maximum useful range between the



Through the wringer

Since September, 1981, when the U.S. Army began a grueling series of tests on their CH-47A Chinook helicopters, they have really put it through the wringer. When the Army completes development testing on it this fall, the Chinook will be as thoroughly tested as a helicopter can be. They have flown it in desert heat where the aircraft was lowered continuously for four hours to a dead weight at an outside air temperature of 116°F. The Chinook has been operated at tempera-

tures down to minus 45°F. It has been subjected to severe static tests and many of the environments it will encounter. They've pushed it full of troops and weapons, and with pushing static components and vehicles such as Gamma West as compatibility tests. They have carried heavy loads and pushed it to see if Chinook can take it. It can. It can because it was designed by Boeing's Vertol Division to meet all the

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two objects moving relative velocity is being measured. Because gamma rays are isotropic and absorbed in the atmosphere, the effective range may be only a few hundred yards under certain conditions. In space, range of several miles appears possible, depending upon the source material used, according to Martin engineers. Pasadena, Kansas. Mostbauer materials have proton energies ranging from 3-140 MeV. The system is not basically sensitive to variations in magnitude of photon density providing a sufficient number are received by the detector.

Martin engineers currently are making measurements to determine the minimum number of photons needed for satisfactory operations.

Secondary Effects

While the principal factor that determines whether or not resonance occurs is the relative velocity between source and absorber, along a line connecting the two, there are other secondary effects. This suggests that the Mostbauer Effect might find use as a means of measuring acceleration, true position, pressure or the magnitude of a magnetic or electric field.

Some idea of the relative number of nuclear resonances for these factors can be gained by comparing them with the primary longitudinal Doppler Effect for iron 57, a velocity of 1 cm/sec causes a shift of 50 mHz or half line width, normally expressed as "10 gamma," according to Dr. Louis Bissman, principal staff scientist for the division. In theory, the upper limit of resolution in detecting the presence of nuclear resonances appears to be about 0.001 gamma, but Martin's Mostbauer says "we will be happy to achieve a 10-gamma resolution since that provides more than enough accuracy for most applications."

Here are comparative sensitivities for secondary factors influencing nuclear resonance:

- Temperature: 0.0015 gamma/deg K
- Acceleration: 0.001 gamma/g
- Pressure: 0.12 x 10⁻⁶ gamma/atmosphere

Magnetic Field

The presence of a magnetic field of more than roughly 1,000 gauss or an electric field of 1,000 V/cm across the source or absorber also produces a slight shift in resonance, but the precise relationship has not yet been reported, it has been assumed.

For velocity measurement, however, two objects in which these data govern the strength of the shift 37 need be only a few millimeters. The gamma radiation thus detected at this level is so light that the material can be handled without any risk of background radiation damage unless the radioactive material was

nonzero to enter the bloodstream through an open wound, Mostbauer says. For use with longer ranges, say in space, a more intense radioactive source would be required. For example, to achieve a range of two miles in a co-operative satellite, nondestructive detection might require a source of 10 Ci. Thus, Mostbauer concludes would require shielding to protect a spacecraft passenger and on the ground would require the use of manipulation to handle such a source. Generally speaking, the use of the radioactive source needed goes up with the second power of separating distance between it and the absorber.

The presence of gamma rays from cosmic or other sources contributes for the new technology the equivalent of "background noise" in radio communication systems. However, Martin engineers say it is possible to filter out

most extraneous gamma rays by using the non 57 absorber sufficiently thin so that it can not produce sufficient gamma rays to obscure the desired energy level. Also be choice of the thickness of the medium (radio crystal) in the non-fluorescence, photons below the energy level of interest will not penetrate the crystal while those above the level of interest have to reach enough that they will pass right through without producing light photons to obscure the counter. In addition, pulse height discrimination techniques are employed in the system to detect gamma ray energy levels which are not of interest.

Martin spokesmen are bullish over the potentialities of the Mostbauer Effect. Although there are several hundred scientists working in the field, the company believes it is one of the first to attempt to apply it to functional tasks other than basic research.

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► **Lightweight X-Band Backward Wave Oscillator**—A resonant magnetron backward wave oscillator weighing less than 1 lb is under development by Hughes ST and SO, Inc. Output between 2.5 and 11 g (line 1) is being developed by Microwave Electronics Corp. The oscillator uses 150 or 200 W with magnetic shielding, two shields of which is somewhat for a magnetron that supplies a 500-gauss field. The device operates at a low efficiency (10%) but provides enough power to run a magnetron.

► **Underwater Interceptor**—A small, deep-diving, electrically powered submersible, for the range of 100 ft, being developed by the Naval Ordnance Test Station, China Lake, Calif., may be the forerunner of a new class of small, deep-diving interceptors designed to track down and destroy hostile nuclear submarines. More is intended to be fast and maneuverable and to carry a small warhead, probably no more than two tons. As a background research vehicle, it is aimed primarily at exploring new concepts applicable to submersible warfare vehicles, such as power source, hull and structural materials.

► **Satellite Inspection Fleet Study**—A study of passive communications systems which may be necessary for any satellite inspection vehicles the Air Force body will be conducted by the Air Force Space Systems Division by Hughes, Inc. The study is one of several in a current series to come out of SSG as part of its resumed Project Scout (1980), an satellite inspection program (AW Feb 28, p. 17). The first equipment published will be used to help determine the nature and extent of data processing

by spotting such things as power level and the frequency and character of any RF signals generated within the submersible.

► **Multi-Navigation Sensor**—A stellar inertial Doppler system (SIDDS) which may have wide possible use as a navigation system aboard future Air Force aircraft (AW June 15, p. 23) will be developed by Litton Systems under contract to USAF's Aeronautical Systems Div. SIDDS will combine three types of sensors designed and built to be modular, incorporate part of a single integrated navigation system.

► **USAF Moves Toward Standard Satellite Antenna Package**—Details of an integrated satellite antenna package, combining navigation, telemetry and tracking functions, being built by Space Technology Laboratories for the Air Force's Space Systems Div., were revealed this week, confirming reports (AW Feb. 18, p. 14) that STL had won a competition for this contract work. With this pioneering effort, the Air Force is aiming at deep standardized antenna system with variable and large capacity, applicable to a range of its satellite systems. Known as SCS (Space Control Link Subsystem), the STL subsystem will consist of a single unit combining all three important antenna functions into a smaller, lighter, lower-cost package. The package is equipped by separate submodules. The package will be modular to permit expansion and component changes to accommodate different satellite missions. It will be capable of handling conventional PAM or PAM-like signals, and have capacity for digital telemetry at rates above 60



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now used. The command portion will have packet information capacity three times as high as SCILS will be able to transmit data at real time and has capability for a two-way voice link. As part of the program, SRL also will build a ground station to provide range, range rate and angle tracking data and precision digital telemetry. When completed, SCILS will become part of the Air Force's satellite control facility.

► **Large Space Collector Petals** Fairchild-Lightweight, electroformed collector petals which are suitable for a 45-hr. day, durable periscope collector, or sensor, of the type that could be used with a solar dynamic or thermoelectric energy conversion system in space were fabricated recently by Electro-Optical Systems. The petals, each 22½ in. in length, are made almost entirely of nickel and are larger versions of those used in a SL in the solar collector built by the company two years ago (AW Aug 14, 1961, p. 51). Made to the same electroforming process as their smaller predecessors, the large petals have higher specific weight (under 1 flying ft. of substrate area) in a typical possible application, a collector like this, aboard a space vehicle, would reflect from a closed launch configuration, gather the sun's heat and radiate flame into an energy conversion medium, such as thermoelectric cells, at the focus of the collector. The work was sponsored by the Air Force Aero Propulsion Laboratory of Aeronautical Systems Div.



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Gimbal-less Design May Reduce Gyro Cost

An unusual gimbal-less two-axis displacement type gyro, which performs the functions of two single-axis precision floated integrating gyros at one-tenth their cost, has been developed by the Kollsman Div. of General Precision Aerospace, Little Falls, N. J.

The new type gyro, called Gyroflex, has limited freedom of displacement, which requires that it be used on a stabilized platform, similar to the requirement for a floated integrating gyro.

An experimental model of the new gyro has demonstrated a drift rate of 0.001 deg./hr. with its axis vertically oriented and 0.002 deg./hr. in a horizontal direction, with a one-gauss standard deviation, Kollsman says. However, improved versions are expected to have long-term drift rates as low as 0.0002-0.001 deg./hr. according to project engineer Fred Litty.

The experimental Gyroflex weighs 46 lb. and measures 34 in. in diameter, using a gyro motor operating at 24,000 rpm. Litty believes that size and weight can be reduced appreciably without significant loss of gyro accuracy. The basic Gyroflex concept also can be applied to a low-cost rate sensing gyro.

Kollsman currently is building prototype units for test in company's Marine miniature inertial platform and has made proposals on the order to the Army Ballistic Missile Agency, National Aeronautics and Space Administration and other agencies.

By eliminating the need for gimbals and associated gimbal bearings of a conventional two-axis displacement gyro, the float, pivot and flexible links of a floated integrating gyro, the new design provides a less complex unit which is far less critical to fabricate and assemble, Litty says. For example, the unit can be assembled in an ordinary fabrication-type environment rather than requiring assembly in special "clean rooms."

The gyro rotor is supported in a cantilever fashion and drives through a unit and necked-down shaft attached to the gyro shaft of the integrating motor (see sketch). So long as the gyro case remains stationary, the gyro rotor will spin in a plane which is parallel to the plane of rotation of the motor and perpendicular to the main motor shaft.

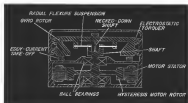
If, however, the gyro case is rotated slightly due to an angular displacement of the vehicle in which it is mounted, the motor and its shaft will be displaced through the identical angle because it is secured to the one through the unit bearing. But the angular orientation of the gyro rotor at the other end of the cantilevered shaft will cause it to attempt to maintain its

original position in inertial space, at least initially. This it can do because its cantilevered shaft is intentionally made sufficiently rigid (see sketch). A thin spring flexure suspension, attached both to the inside of the gyro rotor and to the non-cantilevered portion of the motor shaft, produces a reaction torque which then causes the rotor to precess at right angles to the original displacement.

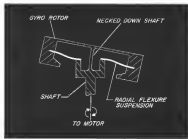
The gyro rotor displacement is detected by eddy current pickoff coils which provide a signal to the servo sys-

tem of the stabilized platform on which the device is mounted, resulting in angular displacement of the platform about the appropriate axis to move the gyro case through an angle equal and opposite to the displacement of the serving vehicle which initiated the cycle. This will return the spinning gyro rotor to a plane which is again parallel to the spinning motor rotor and perpendicular to its shaft.

There are two torque constants associated with the Gyroflex design which must be compensated for to prevent



TWO-AXIS DISPLACEMENT gyro without gimbals has accuracy comparable to floated integrating gyros, but costs only about one-tenth as much as two floated units needed for two-axis operations. Spinning gyro rotor is at end of cantilevered semi-rigid shaft (above). When gyro case is displaced (sketch below), gyro rotor tries to keep original position but motion of radial flexure suspension causes it to precess at right angles to case displacement. Eddy current pickoffs sense displacement and generate signals which cause platform to move through displacement angle.



Kodak reports on:

processing and printing long film by computer ... machine order infrared optics

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This represents the principle of order orientated or non-intermittent processing and printing of long rolls of film by computer—new dimension. The principle is quite simple and not quite revolutionary any more. In its new manifestation it delivers not only an immediate positive but a fine-class negative for future exposures. Perhaps the message will strike right between the eyebrows of some reader who has been struggling hard with the petty details of apparatus for photo-gravure on too rapidly rotating plates for the ultimate purpose of making it more suitable for our burgeoning space and/or photo-lithography. (Probably the peak area of the details has diverted his attention from ultimate purposes.)

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sides than ingenuity and management, hoping that the occasional consumption of our negative materials will reward us for improving the quantity and quality of aerial photography. We can, on a special order basis, supply just the Kodak Bimat Film, which initiates solution, applies it to the negative film, and covers away leaving the positive image. We can similarly supply just the Kodak Bimat Imbedmat. We can likewise supply invisible negative film. We can supply the whole works. We can design the hardware, build the hardware, or strike the head of man who intends to prosper by proving in far competition that he can outstage or outbid us.

Send an application for a preliminary literature to a letter to Eastman Kodak Company, General Development Products Division, Rochester 4, N. Y.

LETRAM model

Kodak Letram 245 lenses for 1/4-1/4 inch to be processing infrared technology, probably for their thermal, mechanical, and chemical ruggedness. These are a class of getting a poorly needed one because they simply don't require special processing. If you can use any specific lens, and send the purchase order to Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y. We can probably ship in a week. If you need more data or more special lenses, phone 716-552-0000, Ext. 5066.

	EQUIPMENT TOTAL LENGTH (mm)	MEASURED BLUR (mm)	
1. 10-100	25.0 compared to 3.1 to 25.0 compared to 30"	0.30	6.77
2. 10-100	25.0 compared to 3.1 to 25.0 compared to 30"	0.25	5.93
3. 10-100	25.0 compared to 4.2 to 25.0 compared to 30"	0.30	6.94
4. 10-100	50.0 compared to 4.2 to 50.0 compared to 30"	0.61	10.68
5. 10-100	10.0 compared to 6.2 to 10.0 compared to 30"	0.30	6.93

Approximate model length of polar source at various measured angles shown in 1/4" of same photo intensity for 1/4" film.

Measure price with 1/4" 1/2" quantities, subject to change without notice.

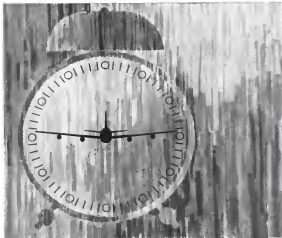
This is another advertisement where Eastman Kodak Company probes at readers for mutual interests and occasionally a little revenue from those whose work has something to do with science.

Freight-to-passenger ratio for airlines gives strong evidence of following railroad pattern. Fifty years showed freight increasing from 20% to 85% of total railroad business. Cargo by air has grown from 3% to 9% in the past fifteen years. Freight by air is a sleeping giant which could awaken with a roar as a result of important shipping economies being made possible by the new Douglas jet freighters now entering service. □ And Douglas is helping awaken the giant in several other fronts. Those include continuing a study

SLEEPING GIANT

...AND WHAT DOUGLAS IS DOING ABOUT IT

of freight movement statistics in conjunction with several major airlines, designing improved terminals and cargo handling systems, analysis of terminal-to-terminal control and, of course, continuing production of jets with lowest possible operating costs.



Douglas research program involves 25 technological areas relating to aerospace and defense systems. Major Douglas divisions are located in Santa Monica and Long Beach, California, Tulsa, Oklahoma, and Charlotte, North Carolina.



EXPLODED VIEW of new Keesler Gyrodes two-axis gyro shows simple construction which permits low cost fabrication. Also shown are the radial flexure suspension, compensation bracket and motor-driven shaft which gyro uses to maintain characteristics.

sensitive drift error. Left, explains Durr is the torque reaction of the flexure suspension which causes the gyro rotor to precess at right angles to the deflection. This is compensated for by mechanical means which Keesler is not willing to duplicate until it has applied for patent coverage.

The other potential disturbing torque, which would attempt to return the gyro rotor to its original position relative to the motor rotor and shaft, arises from masses fixed to or set into motion by the spinning gyro rotor. This is reduced to a negligible amount by venting the gyro and then sealing it.

To make the gyro performance relatively insensitive to its position with respect to gravity and to external g-forces, the center-of-gravity of the gyro rotor is located at the geometric center of the rock-and-roll shaft and the radial flexure suspension. The stiffness of the two support members is designed to provide equal axial and radial compliance to enable the gyro to isolate and

thereafter relatively unaffected by high external g-loads. Gyrodes suspension has been designed for 30 g operation. Accuracy of Gyrodes depends slightly when used as a heading reference because mass shifts along the spin axis will move slightly the location of the gyro rotor center of gravity. However, while a conventional two-axis displacement gyro, Gyrodes has no pendulous bearings which can allow instability in all directions under high g-loads, with resultant increases in gyro drift.

The original version of the Gyrodes contained an electrostatic torque motor to react with the spinning gyro rotor and provide a means for introducing navigation corrections as for steering the gyro initially. A newer design will incorporate a more powerful electro-magnetic torque.

To insure directional stability, the gyro requires an electric heater for its initial warm-up and temperature stabilization. Once gyro has reached system-on-speed, however, power consumption averages only 5 w. total, Keesler says.

greater than 50% peak value over the range will a positive image of a 200-400 line test pattern with a high-light output power density of only 10 microns/cm² with/ing cm. recorded on the photoanode when taken in operation in a standard 50-line TV system. Manufacturer: Westinghouse Electronic Tube Div.

• **Photoanode device**, digital trip-flops and proportional amplifiers, fabricated from photoconductive glass lenses which are fused together in a hermetic seal, are now available in simple quantities. Most samples in-layer units, made to customer specifications, available.



net 5 x 4 x 2 in. Photoanode thicknesses are coated at within one mil. Final amplifiers made of glass can operate at temperatures up to 575°C, or up to 500°C when fabricated from ceramic glass. Manufacturer: Corning Glass Works, Corning, N. Y.

• **Portable CW laser**, helium-neon type, has made retroreflectable mirror assemblies to permit reduction of 0.015% (1/13) motion reduction without disturbing basic laser adjustment. Power



outputs up to 3 mw. are available from both ends. Diode including self-contained power supply, weighs less than 25 lb. Manufacturer: Adams/Polo Alto, Stanford Industrial Park, Palo Alto, Calif.

• **Radiation-resistant** potentiometer, resistor, wire-wound, Model 204H, operates at temperatures up to 500°C with derating from 5 watts at 70°C, and is designed to function in high ion-radiation environments of 150 megarad total gamma radiation and has service reduction of 5 x 10⁻⁴ m/cm², according to manufacturer. Device is available in resistance of 500 to 25,000 ohms, with tolerance of 10%. It measures 8-17 x 0.29 x 1.25 in., weighs 3 oz. Manufacturer: Bussac, Inc., 1200 Columbia Ave., Rossmore, Calif.

NEW AVIONIC PRODUCTS

• **True film** monochrome, Model 701, capable of measuring exposed film at this is 10 kilometers of a given exposure counter (10⁻¹), operates by measuring change in exposure frequency of crystal on whose surface the film has been deposited. Direct measurement is possible without conversion for other physical properties. Accuracy is within 1% for films between 0.05 and 40,000 Angstroms. Device weighs 84 lb., uses solid-state circuitry and is capable to operate. Manufacturer: Westinghouse Scientific Equipment Dept., P. O. Box 565, Pittsburgh 30, Pa.

• **Precision** synchro angle indicator, Type AP1-0015, designed primarily for use with 400 cps synchro is accurate to within 5 mils of arc and has repeat limits of 30 sec. of arc, according to manufacturer. Readout is digital as the gyro and measures with 10-sec. response for a 180-deg. step input. Device operates from 115 v., 400 cps, single phase power. Manufacturer: North Atlantic Industries, Inc., Paramus, N. Y.

• **Resonant** fringe antenna, new line which is sensitive from 2,400 Angstroms to 7,300 Angstroms with response

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TWIGG DIVISION ALTAMIL CORPORATION

BUSINESS FLYING

Wide-Range Attack Angle Indicator Shown

By David A. Brown

Tetrahedra, N. J.-Angle-of-attack indicator for general aviation aircraft, which provides accurate wing incidence information at the high as well as the low end of the aircraft's speed range, gives light aircraft pilots information needed to obtain best cruise and range performance.

Manufactured by Monitor Corp., a division of Van Dusen Aircraft Supplies Inc., the indicator is a simple ball-and-rod mechanism on a wing pylon and attached to a potentiometer. It measures optimum angle of attack for each different wing for each maneuver and displays this on a simple linear indicator in the cockpit.

Attached to the leading edge of the wing within ± 1 in. of the mean aerodynamic chord line (MAC), the vane provides a linear machine for each change in the wing's angle of attack.

Cockpit Scale

This is read in the cockpit on a calibrated scale that shows angle of attack from zero to the stall angle, which may differ with different wings. Correctly, the indicator has Federal Aviation Agency Supplemental Type Certification and is being flown on Cessna 170/172 and 180/182 aircraft and Piper Comanche and Apache series planes. It is being evaluated at present on Beech Bonanza and is scheduled for evaluation on Beech Bonanza and Cessna 310 aircraft.

In line with the move to light twin, the instrument used currently is being redesigned to put the potentiometer in the wing, where it runs more easily, but is tested for older number operations.

At the same time, the size of the mounting case is being reduced from its present 13 x 2 in. size to 1 x 1 in.

The indicator was demonstrated to the Aviation Week & Space Technology show by Monitor President Alvin B. Hunscho at a Piper Comanche, N. J. 11083.

Until the aircraft is flying, the indicator does not work. As soon as the Comanche was airborne and the gear up, Hunscho rotated it to the best angle of climb, in that case a 10-deg angle of attack. This produced what at first appeared to be an excessively low-high condition, but climb rate was steady, and the air speed did not drop off.

Delay of 6 sec, built into the circuit,



MONITOR ANGLE OF ATTACK INDICATOR, here equipped for Piper Comanche use, shows optimum angle of attack for each maneuver and allows pilot to maintain this angle precisely. Indicator shows low angles for climb as well as high angles for low-speed maneuvering. Indicator calibration in aircraft index 10.15 in.

eliminates variation caused by gust loading, which normally lasts from 25 to 3 sec, Hunscho said.

At altitude, Hunscho set the Comanche up for cruise, maintaining the best range angle of 3 deg.

Although steady because of the constant rate, the angle-of-attack indicator is more sensitive than the tapered indicator.

Hunscho locked the control yoke back and forth and the air speed needle varied approximately ± 2 mph from a steady 140 mph.

The attack indicator, however, swung through several degrees of angle of attack on either side of the 3 deg. setting.

Slow-Flight Demonstration

Slow-flight demonstration showed it was possible to fly at extended periods near the stall angle—in that case 15 deg—single by relying on the angle-of-attack indicator. Since the wing will stall at this angle regardless of speed, the tapered indicator and the stall warning can both be ignored.

With gear and flaps down, it was possible to fly the aircraft at a 17-deg angle of attack, maintaining an airspeed of 74 mph.

Landing approach was flown at the optimum angle of attack for that maneuver, 8 deg. It can be flown with the angle as low as 6 deg. or as high as 10 deg. Below 6 deg the aircraft cannot

be flared above 10 deg the safety factor is reduced.

The threshold was crossed at apparent nearly 10 deg angle of attack, and the aircraft rotated until it completed a full-stall landing in the indicator needle showed the 18-deg stall angle.

The indicator is powered directly off the aircraft's electrical system, which can be either 12 or 24 v. A 6 v. version has been developed and is being evaluated by Seon Aeronautical Corp. on its experimental aircraft.

Pilot Reading

The vane swings through an arc of up to 70 deg on some aircraft, giving better than a 1:1 expansion of the wing angle, providing a clear reading to be presented on the cockpit indicator.

Each wing, of course, has different stall characteristics, but this requires only that the indicator read in the cockpit be different for each make of aircraft. There is no change in design of the system.

In the event of abnormal landing, the needle swings to the high angle of attack side of the scale and causes three correct down-draw.

Hunscho said installation time varied between aircraft, but generally took about 30 to 45 min., with low wing aircraft taking more time than high-wing models.

The company currently is studying modification of the dial to permit it to

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² WHERE ELECTRONIC MEDIA ARE INVOLVED.

Honeywell

The system has a 900-hr warranty. Price is less than \$350, plus installation. Polycarbonate is manufactured by Special Electronics Corp. of San Gabriel, Calif., and the end-user is protected by International Investments of Orange, Conn.

Approximately 100 of the cruise model's edge-of-attack indicators are in operation. Booth is writing a computer evaluation of the system.

Aerospace Companies Report on Salaries

Washington—Following is a list of aerospace industry executives and officers with 1992 salaries above \$10,000, and their stockholdings, as they were reported to the SEC.

North American **Guano** of 24 Enchiridion Ltd. has been sold to the U.S. Navy for \$1.5 million. The company is a subsidiary of the U.S. Navy. The company is a subsidiary of the U.S. Navy. The company is a subsidiary of the U.S. Navy.

both ways (see, e.g., the 1971 study by Anderson and Bickel, 1971). The theoretical results of this paper are based on the assumption that the distribution of the random variable of the number of contacts is given by the Poisson distribution. This distribution is the most natural one to assume in the case of a large number of contacts. The theoretical results of this paper are based on the assumption that the distribution of the random variable of the number of contacts is given by the Poisson distribution. This distribution is the most natural one to assume in the case of a large number of contacts.

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stock of C. Overberg, 426-20-1140.
shares of realted stock. T. P. Wetherill
operates 100 shares of capital stock in
relation Mr. Wetherill is a partner in 30
Kendrick Plume Associates & Co. which
owns beneficially 1,001 shares of the com-
pany's capital stock. Mr. Wetherill
owns beneficially 100 shares of the com-
pany's capital stock. Mr. Wetherill is also
a general partner in Nix & Co. which owns
beneficially 1,018 shares of the company's
capital stock. Mr. Wetherill is also a
partner in capital stock of Nix & Co.

[illegible][illegible][illegible]



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2303-2304, 2305-2306, 2307-2308, 2309-2310, 2311-2312, 2313-2314, 2315-2316, 2317-2318, 2319-2320, 2321-2322, 2323-2324, 2325-2326, 2327-2328, 2329-2330, 2331-2332, 2333-2334, 2335-2336, 2337-2338, 2339-2340, 2341-2342, 2343-2344, 2345-2346, 2347-2348, 2349-2350, 2351-2352, 2353-2354, 2355-2356, 2357-2358, 2359-2360, 2361-2362, 2363-2364, 2365-2366, 2367-2368, 2369-2370, 2371-2372, 2373-2374, 2375-2376, 2377-2378, 2379-2380, 2381-2382, 2383-2384, 2385-2386, 2387-2388, 2389-2390, 2391-2392, 2393-2394, 2395-2396, 2397-2398, 2399-2400, 2401-2402, 2403-2404, 2405-2406, 2407-2408, 2409-2410, 2411-2412, 2413-2414, 2415-2416, 2417-2418, 2419-2420, 2421-2422, 2423-2424, 2425-2426, 2427-2428, 2429-2430, 2431-2432, 2433-2434, 2435-2436, 2437-2438, 2439-2440, 2441-2442, 2443-2444, 2445-2446, 2447-2448, 2449-2450, 2451-2452, 2453-2454, 2455-2456, 2457-2458, 2459-2460, 2461-2462, 2463-2464, 2465-2466, 2467-2468, 2469-2470, 2471-2472, 2473-2474, 2475-2476, 2477-2478, 2479-2480, 2481-2482, 2483-2484, 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Color paintings of Redwood discovered near Durrhousen, South Africa

MOON SAFARI

10,000 MILES FOR A 37-SECOND HARBOR

What is the exact shape of the moon? Interference of the earth's shadow has long prevented man from determining it. To solve this mystery, an "eclipse expedition" from Lockheed's Rye Canyon Research Center recently traversed 30,000 miles to Outpost, South Africa. They photographed the moon—under ideal scientific conditions—for the 37 seconds it was glimpsed against the sun's near-perfect circle.

The precise measurements secured by this "moon safari" provide added information on the effects of moon gravity—data of great importance in planning lunar landings and computing the kinetics of vehicles which will orbit the moon.

Lunar and planetary studies are but one of the basic projects under research by Lockheed scientists and engineers at



the Rye Canyon facility. Others include: Astrodynamic: Com-munications, Optics, Plasma, Solid State, Solar, Gas and Biophysics, Thermodynamics, Aerodynamics, Propulsion, Altitude and Space Environment. Research projects at other Lockheed-California facilities include work on America's super-space transport, ADW and Ocean Systems, and Spacecraft.

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SAFETY

CAB Accident Investigation Report:

Three-Engine Go-Around Cited in Crash

On July 12, 1961, an F-100 (1071) in Canadian Pacific Air Lines (CPAL) crashed while attempting a three-engine go-around following a landing approach to Runway 3 at Honolulu International Airport, Honolulu, Hawaii. The aircraft was destroyed by the impact of the landing gear and the tail section of the aircraft was destroyed by impact and fire.

Thirteen of the 40 persons aboard survived the crash. Sixteen other persons (16) were killed or injured. The aircraft was destroyed by the impact of the landing gear and the tail section of the aircraft was destroyed by impact and fire. The aircraft was destroyed by the impact of the landing gear and the tail section of the aircraft was destroyed by impact and fire.

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Investigation

CPAL's Bristol Britannia 314 had crashed on Runway 3 (R07) on July 12, 1961, in Canadian Pacific Air Lines (CPAL) Flight 313 from Vancouver, British Columbia. The aircraft had its last approach to Runway 3 at Honolulu International Airport, Honolulu, Hawaii, on July 12, 1961, at 12:10:00. The aircraft was destroyed by the impact of the landing gear and the tail section of the aircraft was destroyed by impact and fire.

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landing gear failed. The weight and balance showed that prior to the departure of the flight indicated the gross ramp weight of the aircraft was 17,074 lb and the center of gravity (CG) was within approved limits. Examination of the document by Board investigators subsequent to the accident revealed that approximately 4,000 lb of cargo had been loaded in the gross weight and consequently was not reflected in the CG computations. The aircraft's gross weight of the aircraft at the time was found to have been 17,074 lb rather than the 17,074 lb originally calculated. The aircraft's gross weight was found to have been 17,074 lb rather than the 17,074 lb originally calculated. The aircraft's gross weight was found to have been 17,074 lb rather than the 17,074 lb originally calculated.

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XC-142A Simulator Tail Section Shown

Tail portion of Variable-Intake-Rate XC-142A transport simulator, being constructed at Chrysler-Vought's Dallas facility, will have variable control surfaces. Tail section is fabricated by Ross. Simulator is designed to provide Vought's test pilots with a representation of the real aircraft's handling and flight characteristics.

was not within its service in effect that would have restricted the amount from being used for normal or emergency operations.

Takoff Procedure

Takoff was commenced at 2235. At approximately 7 min after the takoff began, the aircraft was cleared to climb to 10,000 ft and to maintain that altitude until the No. 3 engine had been shut down, and then to descend to 8,000 ft. The aircraft was cleared to descend to 8,000 ft and to maintain that altitude until the No. 3 engine had been shut down, and then to descend to 8,000 ft. The aircraft was cleared to descend to 8,000 ft and to maintain that altitude until the No. 3 engine had been shut down, and then to descend to 8,000 ft.

Discharge and take-off were started and proceeded to steadily progress upward to the runway.

Engine 311 had advanced the power that to maintain landing approach conditions, and had following would be required in order to achieve the altitude. The aircraft was cleared to descend to 8,000 ft and to maintain that altitude until the No. 3 engine had been shut down, and then to descend to 8,000 ft.

The aircraft was cleared to descend to 8,000 ft and to maintain that altitude until the No. 3 engine had been shut down, and then to descend to 8,000 ft.

in an emergency truck put off the edge and saw the approach and of the runway prior to the accident. He stated that all conditions observed during the approach appeared to be normal and that the landing gear was in the extended position. He observed no vehicles or pedestrian traffic on or adjacent to the runway. The tower local controller verified his statement that no vehicular traffic was observed on or in proximity to Runway 6. The fix and noise cones provided to the truck were immediately and accurately in keeping the fix from the run portion of the fix which had completely regulated the main section of the aircraft.

Landing Gear Assembly

At this landing gear assembly was removed and, although the engine and the damage was severe, it was determined that there were no signs of any structural damage to the gear. The left main gear assembly was removed, the track was tested and the aircraft cylinder assembly and was fully returned. The right main gear and the nose gear cylinder assembly was also removed from the aircraft position. The nose gear door panel was removed and had no significant edge deformation but was severely deformed on its outer surface, indicating it was in the closed or fully closed position at impact.

Portions of the drive shaft by the landing lights were removed and were determined to be in the fully extended position on both sides.

All right flap assembly (right) was removed and the fully extended position was determined to be a 15 deg. flap setting.

A right flap assembly was removed and was determined to be in the up position.

The control pedestal was removed but was in a severely damaged state and did not have the only significant evidence present was the longitudinal strain indication which was in the rightmost position on both the pilot and copilot pedestals. Other trim settings, control pedestals, or cockpit interior readings could not be determined.

Control pedals, position of pedals could not be determined because of the release down to the right control area from impact and fire. However, there was no evidence to indicate a flight control or speed brake pedal to impact.

Only one of the two left side fuel gauges were in the down position and the damage to the right side fuel gauge was determined. Neither of the two right side fuel gauges were in the down position.

All four engines and propeller assemblies separated from the aircraft during its disintegration and were scattered in the wreckage area. It was determined that the No. 1 propeller was in the fully extended position and that the engine was not operating at the time of impact. Location of propellers Nos. 2, 3 and 4 could not be determined. Only one of the two right side fuel gauges was in the down position. The right side fuel (right) side fuel gauge was in the down position.

None of the engine cylinder intake valves and exhaust valves or exhaust valves for the No. 3 engine had pressure but could not be found in the engine position.

The propeller turbine shaft of engine No. 1 and 4 had been found in the engine position but the propeller turbine shaft of the No. 3 engine. There was only minor impact structural damage to the door assembly, indicated in each of the engines.

Control Unit Assembly

The control unit assembly for the No. 2 propeller was found in the main wreckage area and the main wreckage area was in the "DOWN" position.

There were no significant propeller control assemblies for the No. 3 or 4 power plants.

No evidence was found in any of the propellers including No. 1, that would indicate a failure or malfunction prior to impact.

None of the 13 switches had been tested in the test facility which had been tested in the test facility. The other two switches had been tested in the test facility, which was part of the test of the aircraft. Although they were tested in an area of severe damage, they were found to be in the test facility.

Extensive pathological investigation of the fuel, engine and cylinder assembly showed no evidence of any in-flight operation. Alexander Industries stated that the fuel gauge to the right side of the aircraft after impact.



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■ Standard 100-150 HP and 200-300 HP and 300-400 HP
■ Standard 100-150 HP and 200-300 HP and 300-400 HP

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and engine port prior to the aircraft's descent. On both occasions the observed, Captain Laporte saw that no engine exhaust was in the cockpit in the left seat. First Officer Norton in the right seat, Second Officer Hart in the middle seat, and Navigator Jett in the navigator seat, Chief Cabin Captain Laporte, First Officer Edmond, and Six other Air Force crew were seated in the deck compartment located behind the flight deck.

The weather observation made by the U. S. Weather Bureau at Honolulu International Airport immediately after the accident was as follows: local 2120-2400 ft. sea level (measured at 880 ft. barometric pressure), high ceiling (visibility) more than 10 mi., temperature 74F, dewpoint 67F, and surface wind 7 to 10 mph with gusts 1800 to 2000 mph. The weather was not observed at the time of the accident.

Review of the U. S. standard configuration "A" approach lighting system at Honolulu International Airport revealed that the system includes a row of green threshold lights and white, high intensity runway lights. All lights, with the exception of the runway lights, were on and operating throughout the approach of C142GS.

Warning System

The landing gear aural warning system installed in the Hercules was designed to determine its position in relation to the aircraft ground speed of 100 mph. Two sensors receive visual and aural signals through independent electrical circuits in an attempt to warn the pilot of the onset of an unsafe gear condition. The visual system utilizes two red hazard position lights located on the cockpit. The aural system receives its information from three, separate, and distinctive, modulators and reports with a horn warning when any

of the three is activated and the gear is not in the extended and locked position. Since there are separate sensors with independent position indicators it is possible for contradictory indications to be received as the cockpit in the event of failure of certain position indicators.

A review of the standard configuration for the Hercules revealed that the gear is not in the extended and locked position.

Nozzle Liner Tested

Solid propellant engine nozzle tests have been completed at the NASA Langley Research Center, Hampton, Va., for the purpose of determining the effect of nozzle throat erosion on engine performance.

The tests were conducted at the NASA Langley Research Center, Hampton, Va., for the purpose of determining the effect of nozzle throat erosion on engine performance. The tests were conducted at the NASA Langley Research Center, Hampton, Va., for the purpose of determining the effect of nozzle throat erosion on engine performance.

one of the throat's is eroded and the gas is not in the extended and locked position. Since there are separate sensors with independent position indicators it is possible for contradictory indications to be received as the cockpit in the event of failure of certain position indicators.

A review of the standard configuration for the Hercules revealed that the gear is not in the extended and locked position. The gear is not in the extended and locked position. The gear is not in the extended and locked position. The gear is not in the extended and locked position.

The CPV Between Flight Manual does not contain specific instructions regarding the engine ground speed sensor when the aircraft is in low altitude. The manual does not contain specific instructions regarding the engine ground speed sensor when the aircraft is in low altitude. The manual does not contain specific instructions regarding the engine ground speed sensor when the aircraft is in low altitude.

Analysis

As far as could be determined, approximately 15,000 ft. of fuel was consumed in the powered descent. Following the completion of this approach the aircraft was in a steep climb. The aircraft was in a steep climb. The aircraft was in a steep climb.

The gear landing weight of the aircraft at the time of the accident landing has been estimated at 134,000 lb. The gear landing weight of the aircraft at the time of the accident landing has been estimated at 134,000 lb. The gear landing weight of the aircraft at the time of the accident landing has been estimated at 134,000 lb.

From the probable approach trajectory, based on observations of terrain and air masses in conjunction with the wreckage distribution pattern, the aircraft was estimated to have been in a steep climb at the time of the accident landing. The aircraft was in a steep climb at the time of the accident landing. The aircraft was in a steep climb at the time of the accident landing.

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Go-Around Attempt

The second is useful to determine the reason why a proposal would have been attempted if so late a step in the approach with the search staff as the full landing configuration. There was no reason to indicate a gear-related was proposed in order to avoid any obstacles (which as pilots know) that may have been on the runway.

The problems of a fuel container container running from a fuel container system and handling was presented to one of the parties in the investigation for consideration in the Board. It was stated that a fuel container valve on the right wing did not close, following the fuel atomising system resulting in an uncontrolled fuel flow condition. It was noted that this condition prevented a control problem at forward which accelerated as presented. The Board therefore considered this aspect and has concluded that the fuel container valve was not closed, and the fuel container system failure could not have resulted in the explosion of aircraft that was involved in the crash of the aircraft.

Although it is wrong to say that the application of organic growth power is the best to the left. This implies that power was not applied because of an immediate lifting down condition, but rather that power application caused the condition.

that we always do not

back angle, indicating a predominance of eye, without the influence of an asymmetrical and/or loading condition.

The digital back angle which was present at impact would be that which was induced by the saw.

These facts, along with other evidence detailed in this report, offer an alternative take to a long-standing problem within the medical

The remaining main observation and supporting reason for a generalized model for pre-devised circumstances, would be the strength of a usually leading grey woman (and/or light) in the subject when the identities were judged. However there was no physical evidence found to substantiate this, *see below*.

The investigators created no restraint of an actual fix, as the Net 1 target, so we thus, any indication of power below

It was determined that engines Nos. 2, 3, and 4 were shortchanged (idled) 2000



SOLUTION: Charge Vought's JC887A V/33DL (sample) under development for the design, draw, and cut forms. Designed for versatility, the 3.3" wide roll

Any person who has been convicted of a crime involving the use of a firearm within 10 years of the date of the offense is prohibited from possessing a firearm.

The in-service KO 1424 is just one of the many interesting programs

now being investigated by Chance Young engineers and scientists. Other key programs include LARX, SCOUT, LANCE and CRUSADER. Perfecting the science of a single movement at Houston will lead the way with the

the best technical talents are needed. Engineers and scientists who qualify will be given extraordinarily stimulating responsibilities in fields such as

AERODYNAMICS Experience in aircraft and missile performance analysis, stability drag calculations, tests of climb, and evaluation of range

and crane hoists. Assignments may involve stability and control while utilizing fixed and moving base simulators and/or the establishment

and stabilization surfaces. **OPERATIONS RESEARCH** Supervisory

of advanced space missions leading to the definition of overall systems requirements. The evaluation and comparison of alternative systems will

Concepts: Construction of mathematical models and its conducting simulations. Cost analysis and long range technical planning. Detail operations

ELECTRO-OPTICS SYSTEMS Experience in electro optic systems.

analysis and detail design. Experience should include plans/work for 20% scanner and/or star tracking systems, experience in optical and servo

design/analysis experience with applications of simulation theory to systems performance analysis. **CONTROL SYSTEMS DESIGN** Experience in the design of software control systems, including simulation.

such as electrical electronics and hydraulic control systems. Many analyses on pneumomechanics result and analysis. ■ If your interests lie

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INTERNATIONAL AIR TRANSPORT ISSUE

October 7, 1963

To meet the information challenge created by the international character of aviation, AVIATION WEEK & SPACE TECHNOLOGY publishes each year an issue devoted to international air transport progress. This issue is enriched with such authoritative response that it will again be greatly expanded to provide the most comprehensive analysis and forecast of the air transport industry and its technical developments.

Publishing date is October 7, 1963, timed to coincide with the annual general meeting of the International Air Transport Association (IATA) in Rome. Copies of the issue will be flown to Rome for distribution at the opening plenary session to airline executives, IATA delegates and other world aviation leaders.

Issues there will be the current problems in international air transport including bilateral agreements, rates and tariffs, flight equipment, passenger mail and cargo traffic, air traffic control, the capacity issue, exchange of international routes. Other subjects central to a full analysis of the airline industry world will be viewed including trends in supersonic transport development, military transport operations, service to Russia and Communist bloc airline activity, impact of U.S. international transport policy on world political and industrial relations.

Future treatment will be given to trends and projected future prospects for traffic growth and development of flight equipment in all major world markets: North and South America, Atlantic Pacific, Europe, Africa, Middle and Far East. Ample illustration will include the current specially prepared charts and graphs to show growth and forecast trends.

This impressive but all inclusive staff for coverage will include the world-wide editorial staff of AVIATION WEEK & SPACE TECHNOLOGY. Timeliness of the issue date combined with AVIATION WEEK's reputation as the authoritative, respected voice of international aviation promise to make it the most important advertising opportunity of the year for your equipment, products and service to the airlines. Mark this year talk in air transport at a time when attention will be focused on major industry issues.

**Aviation Week
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impact. Additionally, it was estimated that a half-popular speed of 1,000 rpm had been selected and stressed on all operating poppels, prior to impact.

The most reliable blade-angle evidence from an accurate reference, independent test obtained from the No. 2 poppel, a lock test at an angle of 21 deg. Subsequent analysis indicated that the Nos. 2 and 4 poppels actually were in resonance with No. 3 at block angles of 21 deg.

From the foregoing, poppel behavior was covered as determined (but 2, 3 and 4 rpm and 25 deg. blade angle combination could have absorbed the engine thrust power at a max. impact of 50 ft. This overall speed is considered valid in view of the operational conditions of impact.

Information is obtained from the United Kingdom, Co. through the British Air Research Board concerning the resonance control speed at landing (No. 1) for the B-70 aircraft. The information is based on an overall gross weight of 170,000 lb., a temperature of 100 deg. at 45 deg. total wing incidence and a threshold speed of 175 at extended impact. It was found that under the above conditions and with an assumed engine that does not in poppel, indicated a shock gradient of only 0.115 to approximately 1 ft. 1 deg. could be obtained after extensive impact tests had been applied to the operating engine. The report stated that at impacts below 100 ft. (No. 1) and under the same conditions a highly impermissible first deceleration could be maintained. According to the factor data, maximum overall operating under similar conditions should be capable of maintaining directional control and preventing acceleration on these engines of 1 g. would be absorbed at an impact of 100 ft.

When the test to the engine a flight test was performed by CPV regarding the general performance and characteristics of the B-70 engine at full landing conditions from both the No. 1 engine response and its poppel behavior. The test was conducted at 4,000 ft. msl with the aircraft angle at approximately 10 deg. to a threshold speed of 175 ft. Under these conditions a maximum was observed without using the flap, from the 15 deg. position. Maximum power and max. rpm, selected while holding the airport at 115 ft. Coasting action for the loss of directional control was attempted in the use of rudder and aileron but a slow left turn developed and a loss of 120 ft. occurred. An attempt to increase aileron and rudder, under the test, the rudder deflected resulted in a loss of airport. The test was then reduced to 30 deg. the aircraft climbed over rudder full control. However, a loss of about 40 ft. of altitude was noted during flap extension.

The test flight did not easily duplicate the conditions under which CPV was operating. It was conducted at 4,000 ft. msl, rather than sea level, a reduced speed, help of ground effect and visual reference.

From all the evidence available, the Board concluded that a potential was a limited shortly after the aircraft had crossed the runway threshold and while it was still in a full landing configuration. The steepness of the approach during the

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President W. A. Paine and Dr. J. F. Simon, Director of Research at the Lockheed-George Company, examine a scale model of the new 45-acre Research Center scheduled for occupancy by mid-year 1964.

Drawings in the fields of: Aerial Structures (Basic Loads, Strength Analysis, Fatigue Analysis), Flatter and Vibration, Sound and Vibration, Aerial Research Engineering, Flight Test Engineering, Aerodynamics, , Operations Research, Mechanics, , Computer Programming

*Sent complete record, in confidence, to Thomas J. Thorpe, Professional
Employment Manager, Lockheed-Georgia Company, 804 West Peachtree
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An exact opposite analysis

namely in conjunction with the evidence of a better range of land it might own. Since the responsible factors are not the same as those which could be

[illegible]

Probable Cause

The lowest difference is that the probable cause of the accident was the attempted Go-around passed when the aircraft was in a full landing configuration, at an excessive speed and altitude to maintain control.

By The Civil Associates Board
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SUPPLEMENTAL DATA

Revisiting the Plan

The Civil Aeronautics Board was notified of the accident on 0800 on July 23, 1966. Board investigators were immediately dispatched to the scene and an investigation was initiated and conducted in accordance with the provisions of the Convention on International Civil Aviation dated Dec. 7, 1944 and the provisions of Title VII of the Federal Aviation Act of 1958, as amended.

Air Conditioning

Canadian Pacific Air Lines Ltd. holds an Air Transport Board license and a valid operating certificate issued by the Canadian Department of Transport. The aircraft also holds a permit issued by the Civil Aeronautics Board to engage in foreign air transportation between a terminal point or points in Canada, the intermediate point, Honolulu, Hawaii, Canton Island and Fiji and terminal points in Australia and New Zealand.

Flight Personnel

Captain Wilfred T. Jennings, age 45, held a valid Canadian airline transport certificate No. 425 with a British Columbia endorsement which was dated May 15, 1962. His medical certificate was renewed on Feb. 9, 1967, with no warning and his last performance check was conducted on Jan. 8, 1967. Captain Jennings held a total of 13,190 hours of which 932 hr. were

on B-29's aircraft. In addition to his training flights, he had, as captain, piloted two gear-thrust engine landings at the B-29's under actual conditions.

Captain Alfred A. Capone, age 93, the oldest captain in the fight, held a solid Canadian when, amongst evidence, No. 593 with a Nationalist aircraft endorsement which was dated Aug. 7, 1949. His medical certificate was issued on May 15, 1962, with no surgery and his last proficiency check was conducted on June 21, 1962. Captain Capone had a total of 16,671 flying hours of which 1,626 hrs were on Hercules aircraft. He had signed the flight clearance for the flight mission as this was Captain Jennings first flight over this area on this recent arrival. This was in accordance with company procedures.

First Officer Clarence J. Norton, age 32, held a valid commercial pilot certificate, No. 0140, with Instrument and multi-engine ratings which was dated April 18, 1960. His medical certificate, was renewed on June 21, 1962, with no waivers and his last proficiency check was on May 15, 1962.

First Officer Norton had a total of 3,695 flying hr., of which 1,517 hr. were as Instrument pilot. In addition to his training flights, he had, as first officer, made five prior three-engine landings under actual conditions.

First Officer Donald A. Aichele, age 38, was a Commercial Training Pilot, held a valid Commercial Pilot, Transport Category, No. NDA-793, with a Instrument rating and 10,000 hr. of flight experience, of which 1,000 hr. were as Instrument Pilot. He had made 100 three-engine landings under actual conditions.



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3,600 lbs. with no warren and last post-mortem check was conducted on Apr. 31, 1962.

First Officer Edward E. Felt, age 28, had a valid Federal Navigator rating, No. 214 VFA 100, with a Brazilian search engine used which was dated Apr. 25, 1960. His medical certificate was renewed on May 19, 1962, with no warren. Second Officer Felt had a total of 4,214 hr. of which 956 hr. were as Brazilian search.

Navigator Roy D. McLarnan, age 34, had a valid Canadian flight navigator certificate No. 53 dated Dec. 1, 1959. His medical certificate was renewed on May 14, 1962, with no warren and his recent flight check was satisfactorily completed on Apr. 1, 1962.

Navigator Ronald D. Hall, age 35, had a valid Canadian flight navigator certificate, No. 54. His medical certificate was renewed on June 14, 1962, with no warren and his recent flight check was satisfactorily completed on Nov. 14, 1961.

Purser Henry Bookley, age 35, was qualified as a purser on May 1, 1956 and had his Brazilian emergency communication was passed on Oct. 17, 1961. His medical certificate was renewed on Apr. 24, 1962, with no warren.

Stewardess Auden E. Johnson, age 28, was qualified as a stewardess on Nov. 13, 1955 and her last Brazilian emergency communication was passed on May 10, 1962. Her medical certificate was renewed on June 25, 1962, with no warren.

Stewardess Ursula C. Hadden, age 25, was qualified as a stewardess on Jan. 10, 1955 and her last Brazilian emergency communication was passed on Oct. 31, 1961. Her medical certificate was renewed on Apr. 25, 1962, with no warren.

Stewardess Nancy Chalmers, age 29, was qualified as a stewardess on Apr. 1, 1959, and her last Brazilian emergency communication was passed on May 1, 1962. Her medical certificate was renewed on May 1, 1962, with no warren.

The entire crew received 1430 hr. rest prior to this flight.

The Aircraft

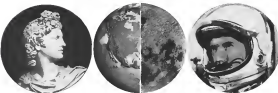
The aircraft was a Bristol Britannia, model 304, Canadian Registry CF-C28, owned and operated by Canadian Pacific Air Lines to aircraft No. 513. It was made functional on May 1, 1958 total No. 11,000 hr. The total time on the aircraft was 6259.52 hr.

The aircraft was equipped with Bristol Profiles 350 engines and Delfinair propellers. No. 1 engine had a total time of approximately 6,685 hr., 1,105 hr. since overhaul; No. 2—approximately 6,311 hr., 1,550 hr. since overhaul; No. 3—approximately 3,806 hr., 912 hr. since overhaul; No. 4—approximately 6,990 hr., 1,214 hr. since overhaul.

The flight times on the propellers were as follows: No. 1 had a total time of approximately 7,584 hr., 1,490 hr. since overhaul; No. 2—4,790 hr., 2,250 hr. since overhaul; No. 3—approximately 3,885 hr. since overhaul; and No. 4—total of approximately 6,440 hr., 1,497 hr. since overhaul.

*Overhaul and flight hour records.

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National Aeronautics and Space Administration
at the Aerospace and Space Committee, Research,
U.S. House of Representatives, 1963.

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RELIABILITY ASSESSMENT... effort includes assisting NASA in assessing overall mission reliability and safety levels, implementing a reliability and failure data system, and reviewing reliability and quality procedures and controls.

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G.E.M. VEHICLE

BuShips has awarded Bell a contract to design and build a high performance vehicle, the SPQR-3 HYDROSKIMMER. Largest G.R.M. program in the U.S. today, this hydroskimmer will be 66 ft. long, weigh 32 tons, and be capable of operating over a foot above water at a top speed of 70 knots.

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AVIATION WEEK, SEPTEMBER 9, 1962

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AVIATION WEEK & SPACE TECHNOLOGY, September 9, 1967

SEP. 12 1963

NOW! SOLID STATE AMPLIFIERS

- Low sensitivity to power supply and load variations
- Low noise, low drift
- Pre-aged — 100 hour operational test
- Silicon Planar Transistors used throughout



Differential Amplifier—ADQ-3 Differential input single ended output • Gain = 20,000 or greater • Gain Bandwidth Product = 1 megacycle • Output = $\pm 10V$ @ 1 mA • Drift less than $50\mu V/^{\circ}C$ from $-25^{\circ}C$ to $+85^{\circ}C$ • Size = $1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{16}$ • Lead Spacing — 0.1 inch grids.



Operational Amplifier—A00-4 Solid state, chopper stabilized • DC gain over 5×10^5 • Gain Bandwidth Product = 2 megacycles • Output = $\pm 20V$ @ 2 mA; $\pm 10V$ @ 7 mA • Drift less than $10\mu V/^{\circ}C$ from $-25^{\circ}C$ to $+85^{\circ}C$ • Plug-in case $4 \times 5 \times \frac{3}{16}$ • P.C. edge connector • No chopper drive required.



Operational Amplifier—A00-6 Photo chopper stabilized • DC gain over 10^7 • Gain Bandwidth Product = 1 megacycle • Output = $\pm 25V$ @ 10 mA • Drift less than $0.5\mu V/^{\circ}C$ from $0^{\circ}C$ to $+55^{\circ}C$ • Long term drift $1\mu V$ per week • Plug-in case, precision connector; $1\frac{1}{2} \times 3 \times \frac{3}{16}$ • No chopper drive required.

With Fairchild Planar reliability built-in, these advanced models introduce a complete line intended to satisfy all requirements for DC amplifiers. These amplifiers offer circuit and systems designers extremely high gain stability vs. bandwidth with low sensitivity to power supply or load fluctuations.

Fairchild offers general purpose utility amplifiers as well as high precision, ultra-stable models employing latest technological advances in circuit design techniques.

FAIRCHILD

SEMICONDUCTOR (INSTRUMENTATION)